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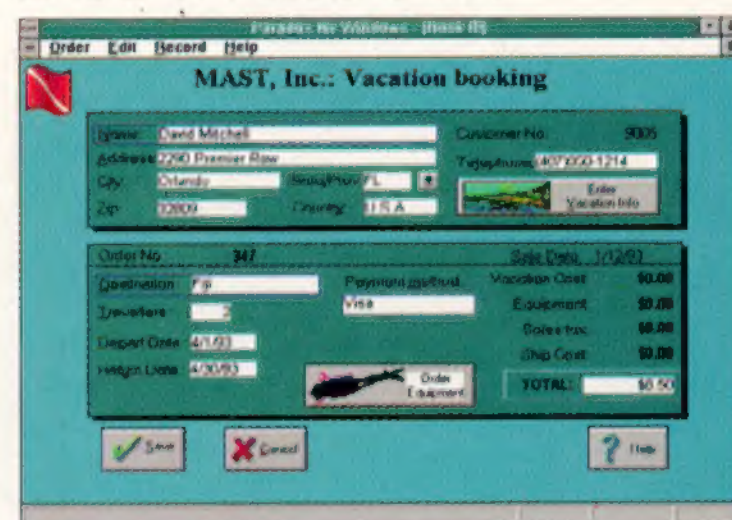
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MAGAZINE

How Safe Are
You? 24 Antivirus
Programs That
Inoculate Your PC

Connecting LANs:
A Guide to the
Fundamentals of
WAN Technology

First Looks:
Finally, Paradox
For Windows



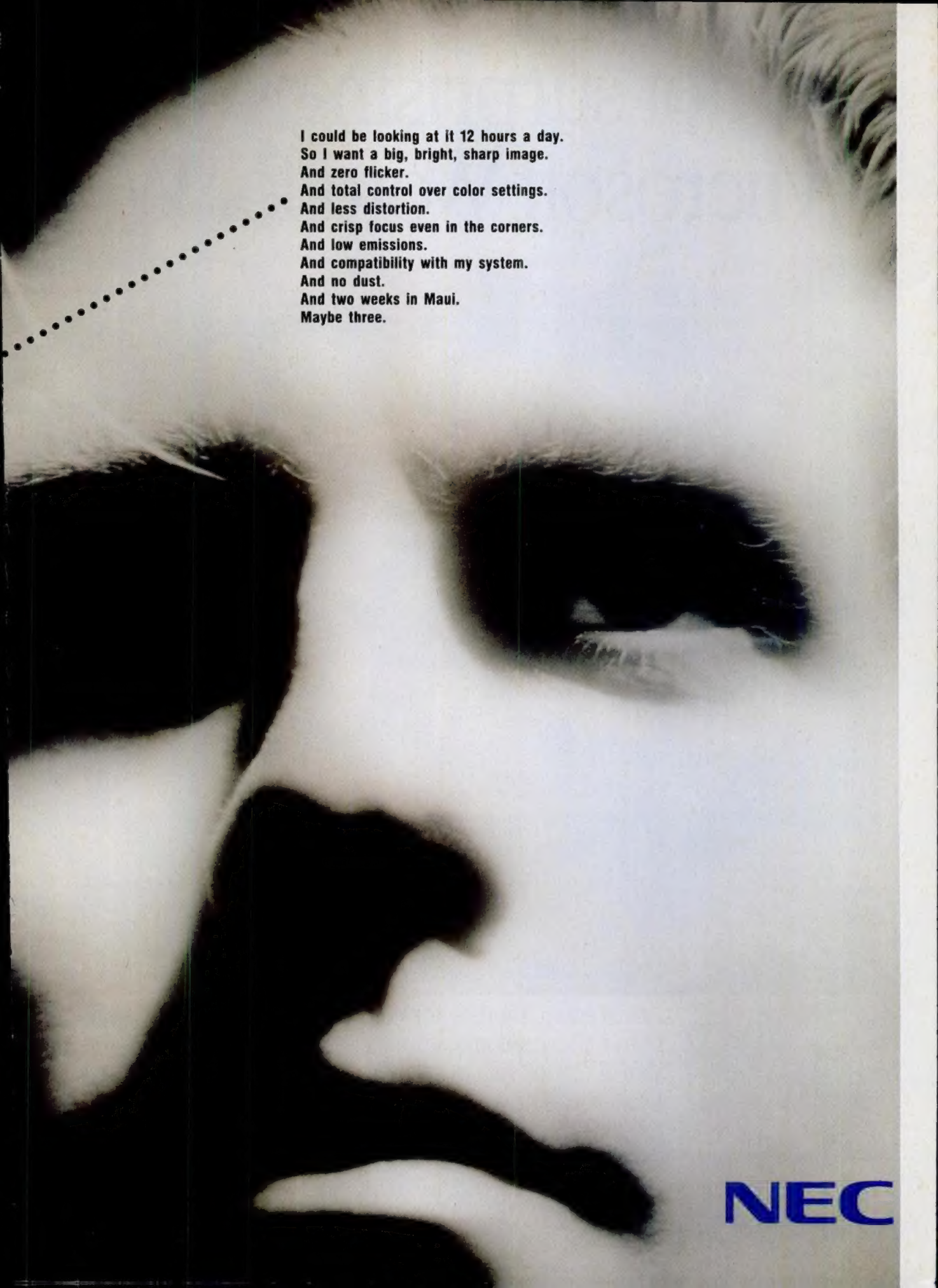
MONITORS, MONITORS, MONITORS!

We Review **58** 14-Inch and 15-Inch Super VGA Displays



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we
monitored
your
thoughts.**

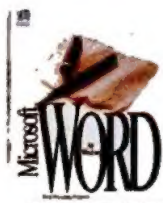




I could be looking at it 12 hours a day.
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And total control over color settings.
And less distortion.
And crisp focus even in the corners.
And low emissions.
And compatibility with my system.
And no dust.
And two weeks in Maui.
Maybe three.

NEC

It's not surprising WordPe Microsoft Word for Wind



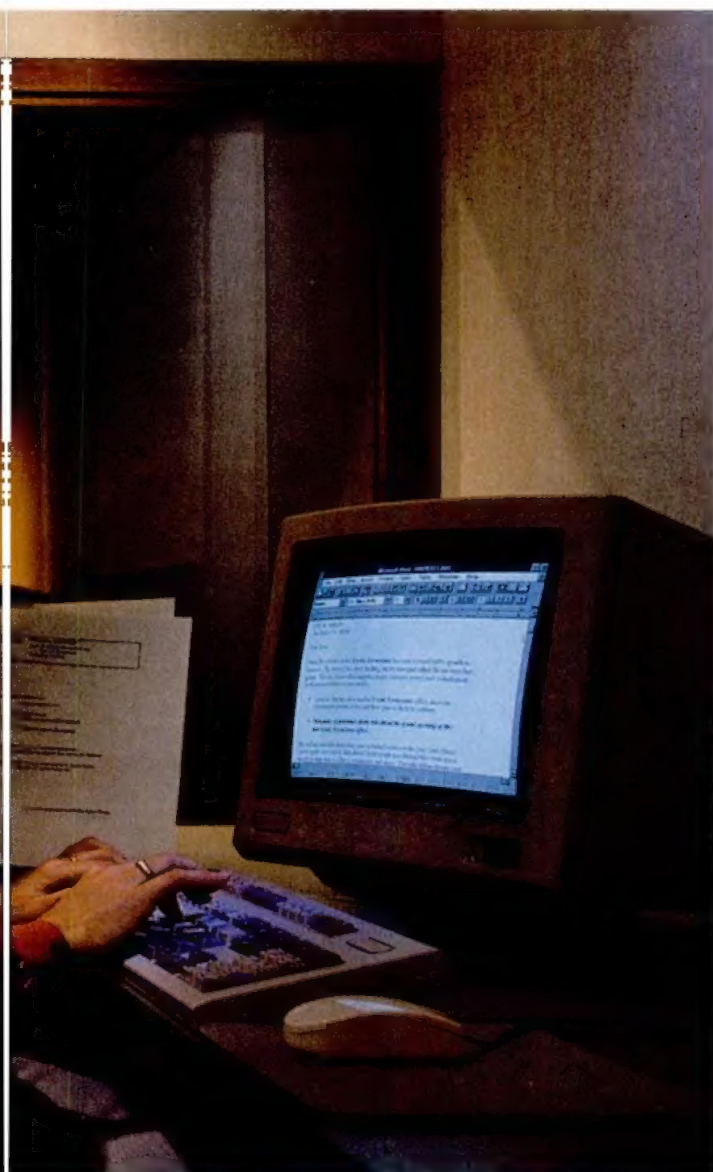
At last count, more than half a million WordPerfect® for DOS users have moved to the number one word processing software for Windows™: Microsoft® Word version 2.0

for Windows. And there are plenty of good reasons why.

First of all, WordPerfect for DOS users actually helped us to make Word for Windows easier to use.

During the development of Word for Windows, we invited WordPerfect

Perfect users are switching to Word for Windows. They helped define it.



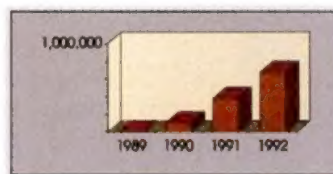
users to try it out on the things they do every day at work. We call these types of sessions "usability studies." They help us find out the way in which people use their computers, and how we can make it easier for them.

In this case, we were able to de-

sign features that can make not only your everyday work easier, but also the transition from WordPerfect.

Like the customizable Toolbar. It gives you one-step access to inserting bullets and printing envelopes. Word for Windows can also take all your famil-

From November 1989 to August 1992, over half a million WordPerfect users have switched to Microsoft Word for Windows.



iar commands in WordPerfect, and then display the equivalent commands. So you can learn while you're

working on your everyday tasks.

We even had the National Software Testing Labs put Word for Windows to the test in ten cities across the country. The result was that nearly 8 out of 10 WordPerfect users preferred Microsoft Word for Windows for ease-of-use over WordPerfect for Windows.

But they're not the only ones who prefer Word for Windows. Recently, it received numerous industry awards, including "Best Buy" by *PC World*, and "Editors' Choice" by *PC Magazine*.

To find out how easy it is to make the switch to Word for Windows, just give us a call at (800) 426-9400, Dept. HY9. And then spread the Word.

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Inside

In this issue, we feature articles on the visible, the hidden, and the frightening aspects of computing. The visible is a product we often fail to give enough attention to: the monitor. We routinely plunk

down several thousand dollars for a powerful PC, specify with great detail the processor, RAM, and storage capacity we want, and then routinely accept whatever monitor the vendor decides to throw in.

The move to graphical environments has raised the standard for monitors. Users want good color, accuracy, and a range of image resolutions. In "14- and 15-Inch Monitors: Mainstream Choices," our hardware team, comprising veterans of our annual mammoth printer project, has tackled a large review of monitors. With the help of ZD Labs and our most finicky writers on graphics and video, they've assessed 58 displays. This story should help you understand the issues better, buy smarter—and save your eyesight.

Debuggers are hidden from most users, but their failures take center stage. That sudden lock-up, the unexpected crash to the DOS prompt, or an unwelcome "general protection failure" message from Microsoft Windows is often caused by programming errors. As programs become even more complex, ferreting out the bugs can be as com-

plex as unraveling a Hercule Poirot murder mystery. Associate editor Sheryl Canter, who writes programs for fun, edited "The Art of Debugging," which walks us through the varieties of software debuggers.

Evil intent is the topic of our story on computer viruses, "Antivirus Software: Keeping Up Your Guard." Statistically,



Help for your code, your data, and your eyes! We review debuggers, antivirus software, and monitors.

most computer users have not had close encounters with computer viruses, but they surely worry about them. The mad stampede to computer stores each time the news media discovers a virus is one measure of the value that computer users place on their data.—Joel Dreyfuss

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PC Magazine, December 1992

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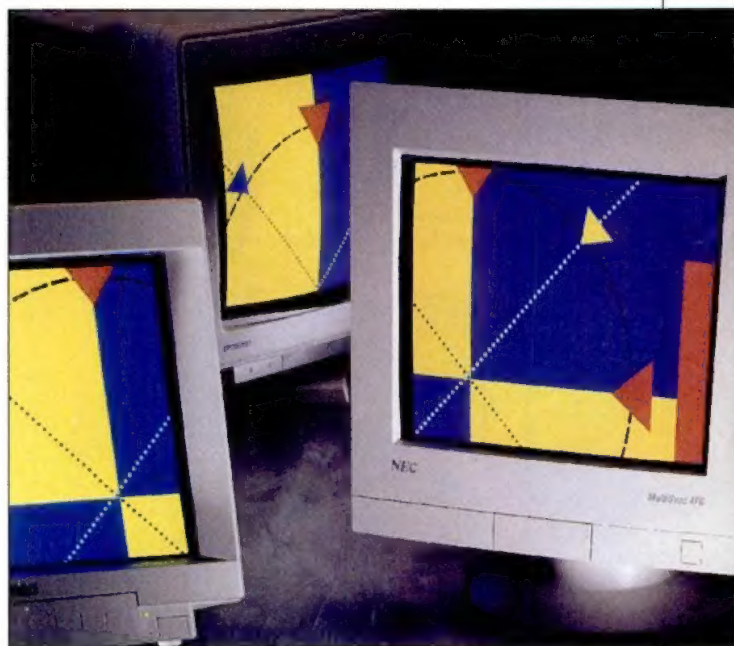
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14-Inch And 15-Inch Monitors: Mainstream Choices



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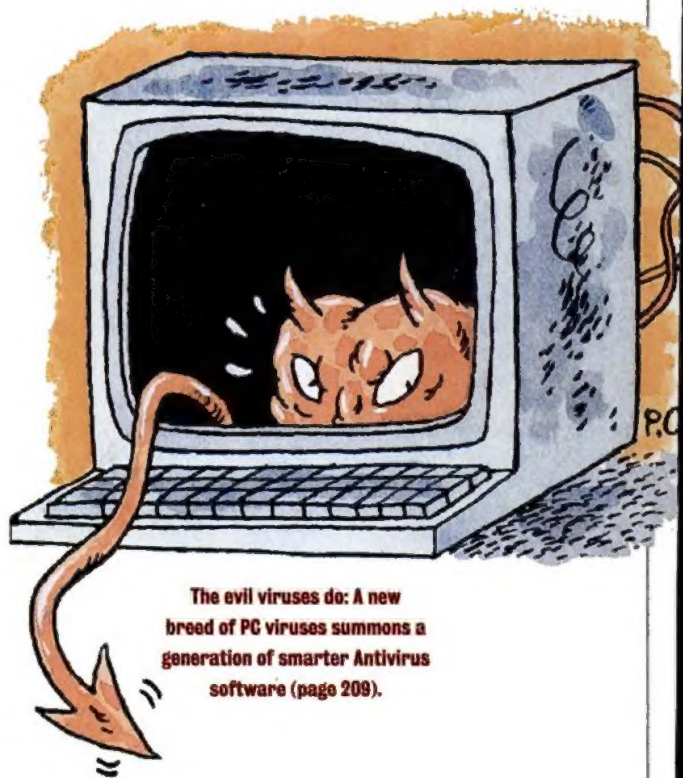
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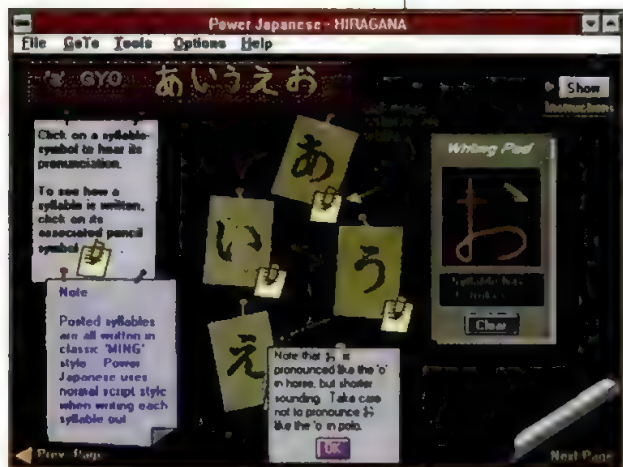
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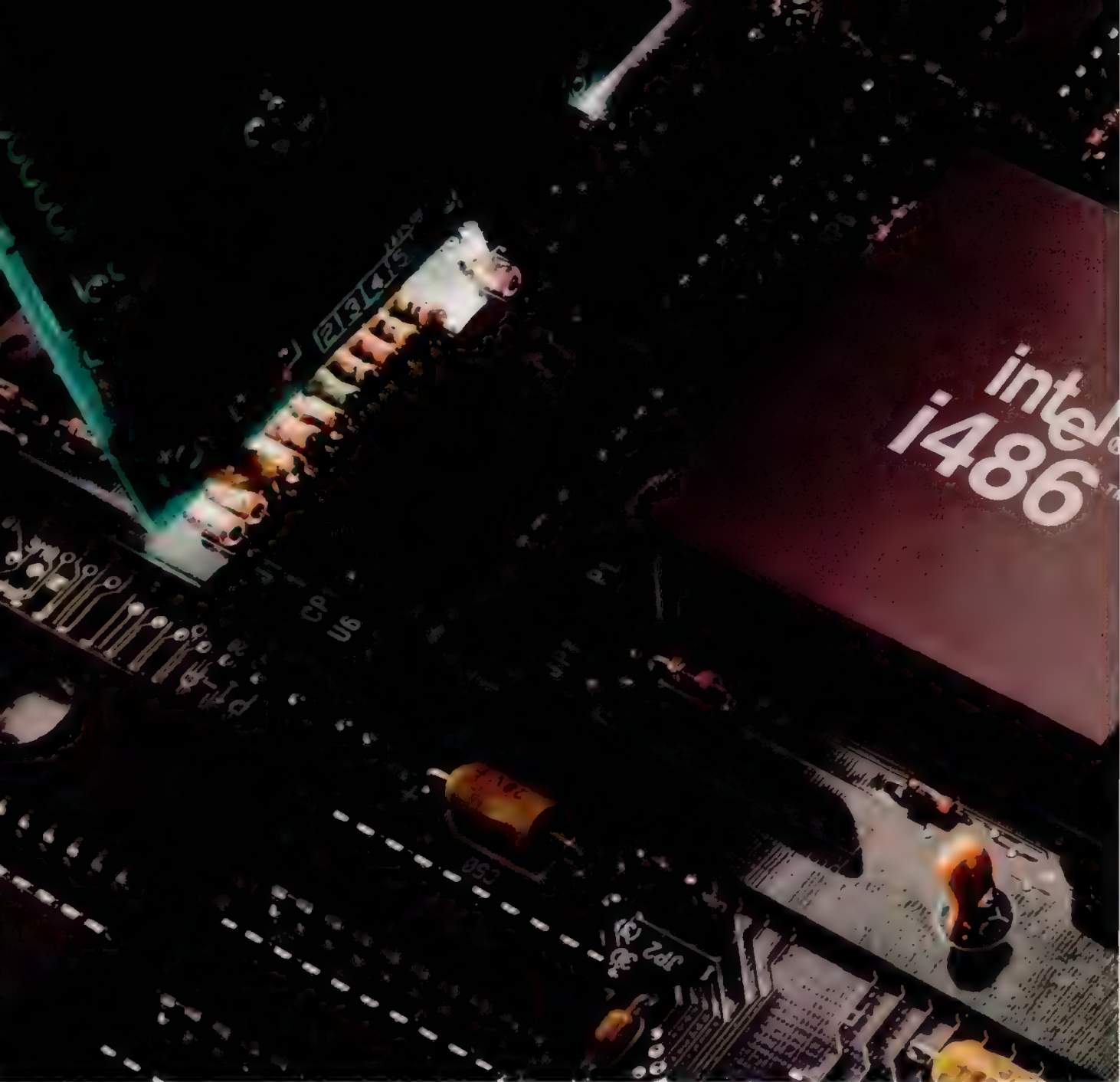
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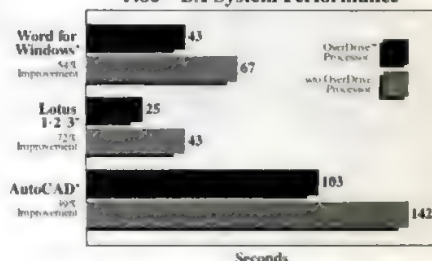
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We welcome letters. However, we cannot look up stories from past issues, recommend products, or diagnose problems with your PC by phone. Send your written questions, complaints, and compliments to *PC Magazine*, One Park Avenue, New York, N.Y. 10016. Please include a daytime telephone number. Send electronic mail to MCI Mailbox 157-9301 or to PC MagNet (see below). *PC Magazine's* general number is 212-503-5255. The West Coast Operations number is 415-378-5500.

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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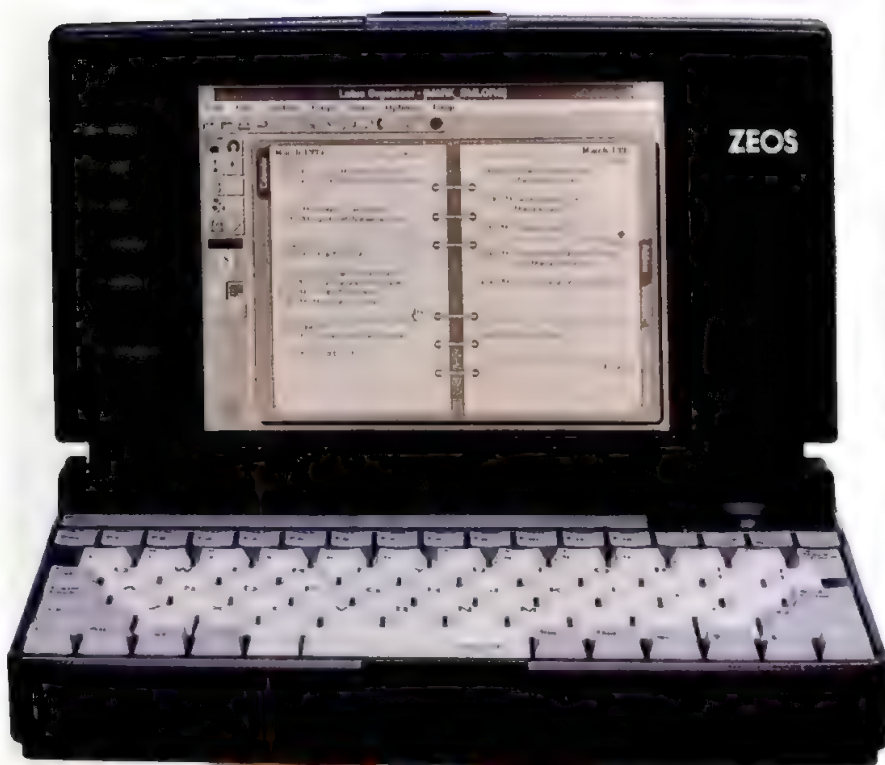
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RAM	2MB to 10MB	1MB to 3MB	2MB to 10MB
Hard Drive	80MB	40MB	60MB
Screen	VGA Backlit	CGA Backlit	VGA Reflective
Runs Windows	Yes	No	Yes
Built-in Pointing Device	Yes	No	No
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CIRCLE 296 ON READER SERVICE CARD

Letters

IS THE FUTURE HERE YET?

Your review, "27 Good Reasons to Buy a CD-ROM Player" (December 22, 1992), was great! However, I do have one complaint.

In your review of Compton's Multimedia Encyclopedia, you neglected to mention that it will not run in SVGA 1,024 by 768 mode. For those of us who run Windows in high resolution, a program like this is of little help. To close down Windows, switch to VGA mode, use the Encyclopedia, exit Windows, and then reboot into SVGA diminishes the convenience of a CD-ROM.

Lawrence M. Hinman
San Diego, California

There are 27 good reasons to buy a CD-ROM drive and one good reason not to—price. If CD audio players can be bought for about \$100, CD-ROM drives should only cost around \$200. Unfortunately, they're still too expensive.

Paul van den Bergh
Fountain Hills, Arizona

REVOLUTIONARY EXCELLENCE

I found your "9th Annual Awards for Technical Excellence" (December 22, 1992) very interesting. I certainly agree with your choices of the PCMCIA and VL-Bus standards, and also OS/2 2.0.

However, I question your ranking of the NEC CDR-74 CD-ROM drive ahead of the Kodak Photo CD system. While the NEC drive may be an improvement, it is an evolutionary improvement; the Photo CD system is revolutionary—introducing a whole new concept in photography.

Clearly, a product with such far-reaching implications is more significant than a faster CD-ROM reader.

Ray Pichulo
Carlisle, Massachusetts

FASTER FAX TIMES

Although your review of Practical Peripherals' Practical Modem 14400FXSA in "Negotiating the Fax Modem Jungle" (December 8, 1992), was positive overall, your fax performance charts indicate fax



"27 good reasons to buy a CD-ROM drive and one good reason not to."

times for our modem double those of the other modems tested. This is not an accurate representation of our product.

The PM 14400FXSA makes 9,600-bps fax connections with virtually all fax machines. However, with an early firmware release, it does fall back to 4,800 bps with certain fax machines, such as the Xerox 7000 Group 3 unit used in your tests. We sent ZD Labs a firmware update that corrects this problem, but apparently it didn't arrive in time to retest. With our current firmware installed, the PM 14400FXSA faxes at speeds comparable to the other modems you tested.

Nancy Stokesberry
Public Relations Manager
Practical Peripherals
Thousand Oaks, California

LEARN TO BE AMBIDEXTROUS

In "Portable Computers: On The Road" (December 22, 1992), you frequently complain about trackballs, which you find awkward. While it's true that some may be more user friendly than others, stating that one is unsuitable for lefties or righties seems somewhat silly. A trackball is not a golf club! Use the other hand!

Joseph M. Ramirez
Pittsburgh, Pennsylvania

THEY MUST BE JOKING!

John C. Dvorak's "Screwball Sales Gimicks" (December 22, 1992) is perfect! To think that IBM would trademark "Crash Protection" is a real joke. How can anyone who tries to pull off this kind of stunt be taken seriously?

Freddie L. Milligan
Boston, Massachusetts

TOWARD A GLOBAL COMMUNITY

John C. Dvorak should be commended for speaking out on the topic of replacing ASCII with a universal character set, "Kiss Your ASCII Goodbye" (September 15, 1992). As businesses in all countries move toward doing more and more international trade, the restrictions of an 8-bit character set make the process of global communications inefficient. When ASCII was established, it was exactly what we needed. It's time, however, to move on.

Scott E. Wrangham
Riyadh, Saudi Arabia

NOTHING IN LIFE IS FREE

In every issue of *PC Magazine* I see a sentence that stands out. A few months ago it was this: "Your best cache buy is one that comes free with Microsoft Windows 3.1: SMARTDrive 4.0" ("The Perfect PC" July, 1992).

It comes "free" with Windows? That's like saying an index comes free with a book. SMARTDrive is an essential part of the Windows package. Without it, Windows would be slow and ineffective.

Bob Cheiger
Portland, Oregon

DO-IT-YOURSELF UPGRADES

"Upgradable PCs" (December 8, 1992), was of no use to me because when I think of upgrading, I don't get the urge to buy another \$3,000 system. I just call my local component importer and get prices for a new VL local-bus 486DX2 motherboard. If you're going to talk "upgrade," please begin to acknowledge the existence of system boards for \$400 to \$800.

Bill Copenhagen
Boise, Idaho

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LETTERS

BETAWARE VERSION 3.0299

Don't you just love the concept of expiration dates on software upgrades? Some of us can't afford to upgrade our software in the one- to three-month window that some vendors allow. We should be allowed to upgrade for free until another version is released.

Edward Mills
Harrisburg, Pennsylvania

Software manufacturers deserve absolutely no loyalty since they offer little or no price breaks for current users when they decide to upgrade their products. They are in such a direct-selling frenzy that they can't see what a disservice they are doing to loyal customers.

My solution is this: Don't upgrade every time a new version comes out. If you wait for a couple of upgrades, you'll get all the benefits of the previous upgrades and only pay once.

Software manufacturers should realize that it's their current users who are paying for the research and development of upgrades. They shouldn't be charged until a major upgrade is delivered.

Larry Chalcraft
Hettinger, North Dakota

KEEP IT SHORT AND SWEET

An acronym is supposed to be a short, easy-to-remember set of initials. PCMCIA, which is used for cards whose standards have been set by the Personal Computer Memory Card Industry Association, is unwieldy, pretentious, and simply too damn long!

Howard T. Atlas
Massapequa Park, New York

BIG BLUE BLUES

While upgrading most computers with Intel's clock-doubling chip (the 66-MHz 486DX2) is usually a relatively simple task, this isn't the case with IBM's PS/2 Model 90.

IBM's technical service people have advised me that in order to upgrade my computer, a processor board with the clock-doubled chip on-board must be installed. You can't simply replace the ex-

isting chip with the clock-doubled one. IBM does it again!

Douglas Boyd
Houston, Texas

SUBNOTEBOOKS DON'T NEED WINDOWS

The breathtaking rise in the popularity of portable computing and the inevitable importance of the subnotebook exposes a glaring shortcoming in your editorial approach, which is centered around the question, "What is the best way to get

*"Don't upgrade every time
a new version comes out. If
you wait for a couple of
upgrades, you'll get all the
benefits of the previous
upgrades and only
pay once."*

Windows on the road?"

Windows isn't the answer. Deciphering icons on a small LCD screen under poor lighting conditions is a strain, and "point and click" is harder than it sounds when you're balancing your computer on your knees. Let's see some inquiry into the best subnotebook software!

Mark Knobil
Pittsburgh, Pennsylvania

SUPERHUMAN EFFORT

Once again, the arrival of my latest issue of *PC Magazine* caused me to shake my head and marvel. As I walked away from the mailbox I heard myself mumble, "How do they keep doing this?", referring, of course, to your product tests and reviews.

While the computer industry screams ahead at a pace that mere mortals cannot possibly hope to match, your magazine does its damndest to help us keep up. Please consider this letter my personal congratulations for the excellent job you do providing timely information to your readers.

Robert E. Neville
San Antonio, Texas

A JOB WELL DONE

I must compliment PC Labs on the new hardware and Windows benchmark tests. They are even better than before, which is important to me since I rely on them for a major percentage of my purchasing decisions. Thank you, your magazine is truly without equal!

Jeffery A. Schwartz
North Caldwell, New Jersey

CORRECTIONS AND AMPLIFICATIONS

WEB Technologies, the defunct data compression company mentioned in "1992 Thumbs Up/Thumbs Down" (January 12, 1993), is not to be confused with WEBCORP, which sells The WEB Network Operating System and is still very much in business.

In the Summary of Features table for the story "Video Technology: Making a Choice in an Era of Change" (January 12, 1993), we mistakenly criticized the Artist Graphics Win-Sprint 100+ for its lack of high-color support. The board does in fact support 15-bit color.

In our coverage of IBM's Ultimedia Tools Series ("Trends" December 8, 1992), we may have unintentionally given the impression that the UTS is a closed or proprietary architecture. It is not. It supports all MCI devices under Windows, as well as ISA and EISA bus machines, and Media-Sourcery will sell non-IBM hardware. All compliance testing by the IBM Ultimedia Tools Series organization (Mountain View, California), however, will be performed on IBM Micro Channel hardware.

HOW TO WRITE TO PC MAGAZINE

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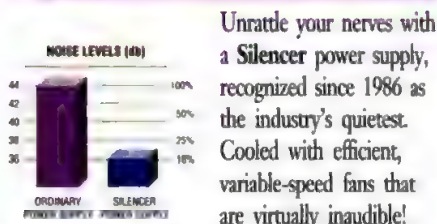
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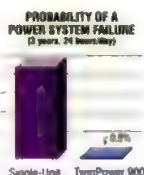


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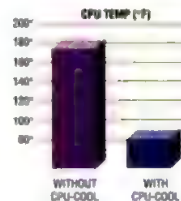
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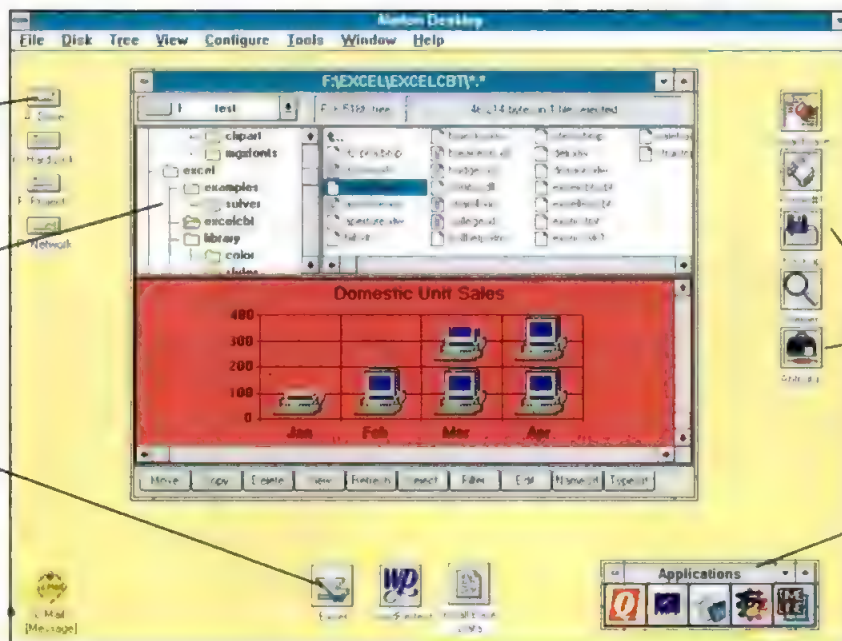


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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Tandy's Zoomer

PCs move into consumer channels.

One year after Apple announced a new generation of computers called Personal Digital Assistants at 1992's Consumer Electronics Show, Tandy Corp. revealed plans for its Personal Information Processor. Code-named Zoomer, the PIP uses an x86-based proces-

sor, a PCMCIA socket, and a pen interface, and it runs the GEOS operating system from GeoWorks.

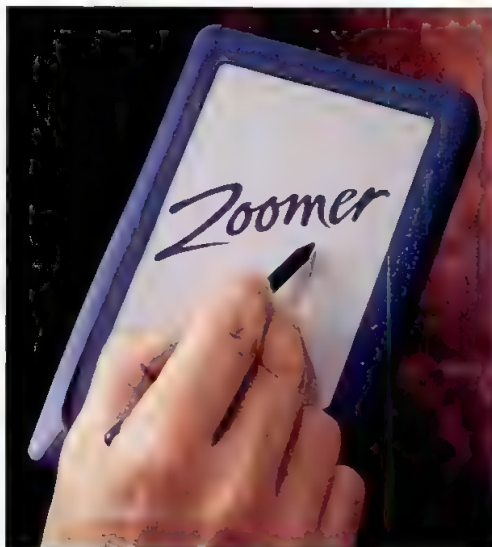
While Apple initially targeted consumers with its PDA technology (code-named Newton) and then switched its sights to businesses, Tandy is developing the Zoomer PIP strictly for the consumer market.

The details are still sketchy, but Zoomer will be manufactured in Japan by Casio Computer and, according to Howard Elias, vice president of Tandy, "will cost closer to \$500 than \$1,000" when it becomes available this fall. It will be small and light, and will use a low-powered processor that will run a long time on standard batteries. As Elias quips, in this market, "long battery life is not measured in hours."

Zoomer marks the rebirth of GeoWorks, which seemed to get lost in the GUI Bermuda Triangle. GEOS, Zoomer's operating system, is a variation of the next major release of GeoWorks, which will be available in the first half of 1993. One of GeoWorks' strengths is its ability to provide a fast GUI environment while running on a 16-bit platform. But few applications were written for GeoWorks because a Sun workstation was the only development platform, and because the software development kit (SDK) was repeatedly delayed. The new version will make it much easier to write apps for the environment be-

cause the SDK will run on DOS.

The first applications for Zoomer will come from Palm Computing, America Online, and Intuit. Palm will supply a personal information manager in addition to



Tandy has set its sights on the massive consumer market with its Zoomer Personal Information Processor, announced at the Consumer Electronics Show in January.

the handwriting-recognition engine. America Online's contribution will handle the communications for Zoomer, including faxing, file transfers, e-mail, and access to on-line databases. Intuit, maker of Quicken,

Continues on page 32

Virtual Audio

YOU'VE HEARD OF 3-D VIDEO, BUT soon you'll be hearing lots about 3-D audio. Calgary's Archer Communications has developed a technology called QSound that makes the sound coming from two ordinary stereo speakers seem like it's all around you. Instead of hearing two distinct channels, left and right, QSound's sounds can be placed anywhere around you, making the experience much richer and much closer to live sound.

QSound can be implemented in two ways. Recording studios can use it during the final mix (when multiple audio tracks are combined into two stereo tracks). The filtering system lets the engineer place the sounds anywhere within a 360-degree space. So far, Madonna, Sting, Paula Abdul, and Luther Vandross, among others, have used QSound in recordings. In film, it was used in *Robin Hood: Prince of Thieves*.

The other method is real-time sound processing through a DSP (digital signal processor) installed on a sound board. QSound recently signed a deal with DSP maker Analog Devices to offer QSound as part of a chip set to sound card makers.

Computer games will be among the first packages to offer QSound on a PC. Virgin Games is already using it in the CD-ROM-based games it makes for Sega systems, and is expected to use the technology in future versions of its PC games.

—Christopher Barr

System 7 Gets Color Management

WHILE WINDOWS USERS WILL have to wait quite some time for built-in color management, Macintosh users are getting it right now. ColorSync, a free extension to the System 7 Macintosh operating environment, makes sure that the colors you scan in, see on-screen, and print out are all the same.

Matching the colors you see on-screen with the colors you get on the printed page is no easy feat, because monitors and printers

Trends

produce colors in essentially opposite ways. Monitors use the RGB (red, green, blue) system, while printers use CMYK (cyan, magenta, yellow, black). The best way to solve the problem is a device-independent color model that defines each color and acts as a reference when translating between different color schemes. Most color-management systems, including Adobe PostScript Level 2, use the CIE XYZ color model, a

mathematical map of all visible colors that assigns a value to each color. This model was developed by the Commission Internationale d'Éclairage (CIE) in 1931 (Trends, November 10, 1992).

Color-management tools have been available for the Mac from third parties for a couple of years. Tektronix's TekColor gamut manager lets Macintosh users choose colors that are supported by both monitors

and printers. Electronics For Imaging's Eficolor and Kodak Electronic Printing System's Precision Color Management System are full-fledged color-management schemes based on the CIE XYZ model. (Both are expected to migrate to the PC by midyear.) But all of these tools are proprietary and don't work together.

Apple's new ColorSync is also based on the CIE XYZ model. But what's significant about it is that, because it comes from Apple, it is virtually guaranteed to become a universal standard. Designed to be predictable and easy to use (with a pop-up menu and a lookup table that profiles the color characteristics of a wide range of devices), ColorSync is intended to provide a default base level of color management for all Macintosh applications and peripherals. Apple is licensing toolkits to third parties and hopes that ColorSync will become a platform for more specialized and advanced color-management applications. Adobe (PhotoShop), EFI, and Kodak have already announced support for ColorSync. And device profiles for Apple's color displays will soon be installed on the hard disks of Apple's new color computers.

On the software side, applications must be modified slightly to include tags with ColorSync information. Apps supporting ColorSync will be available shortly.

Pipeline By Robin Raskin Dere's Gold in Dem DSPs

Digital signal processors (DSPs)—specialized chips that excel at high-speed, math-intensive manipulations—will soon relieve more general-purpose processors from some of their duties. They promise a low-cost, flexible solution for a variety of I/O-intensive environments. They'll show up in everything from palmtop computers to fax/modems to multimedia boards.

DSPs are not new. They've been used for years in many "signal-conditioning" types of apparatus (robotics and radar equipment, for example). But the new crop of DSPs are more flexible; in part because of more sophisticated algorithms. DSPs are also substantially cheaper than processors such as Intel's x86s because they don't do much other than whiz their way through mathematically intensive operations.



So far, Motorola, Texas Instruments, Analog Devices, and AT&T are the primary providers of DSP chips to the PC market. The chips are already available in a number of products, and as these vendors jockey into position, some interesting philosophical battle lines and alliances are being drawn.

The Motorola DSPs are at home on the system boards of NeXT machines, where they supply sound/voice capabilities. Because they're positioned on the system board, with signal lines out to the back of the machine, it's easy to plug peripherals directly into the NeXT's DSP port.

AT&T's DSP handles image processing on the Macintosh and will also be central to AT&T's upcoming line of personal communicators. One recent AT&T-based series consists of image-processing filters for Adobe PhotoShop built into a Mac graphics board (Newer Technology, Wichita, Kansas).

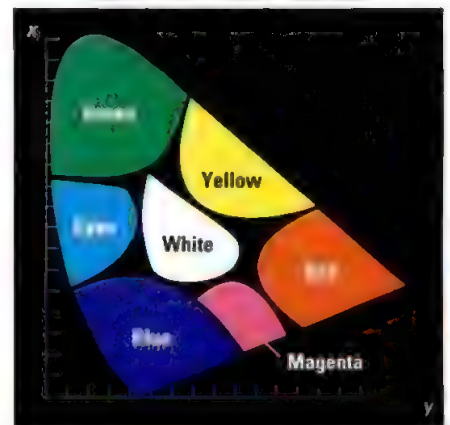
Analog Devices is masterminding the Signal Computing Initiative—an intended industry standard—to produce low-cost peripherals based on its DSP. Already available is Digicom's under-\$200, 9,600-bps soft modem; an Analog DSP with a set of fax/modem algorithms. Analog's DSP also provides the ability to record and play back speech in Olivetti's new PDA, the Quaderno. Compaq intends to use the Analog DSP in future versions of Compaq Business Audio.

Perhaps the most ambitious (and expensive) DSP strategy comes from Texas Instruments, whose DSP comes replete with its own low-level operating system, Mwave. Mwave is really a programmable scheduler, and because TI's DSP can be programmed to allot time to different actions, it's a good albeit more expensive choice for multipurpose solutions. TI markets a fax/modem board and a sound board based on its chip. IBM is using a custom version of the TI chip for some of its most impressive speech-recognition and multimedia products.

PC peripherals buyers will get to decide whether they prefer a strategy such as Analog's, where they buy an inexpensive single-purpose board, or pay more for a combination board that might do voice and video together. In the long term, the modem or video board you buy today could conceivably get better and better instead of becoming obsolete. With all of the "smarts" built into the DSP's algorithm, an upgrade is as easy as changing the software.

Robin Raskin is an executive editor of PC Magazine.

CIE XYZ Color Model



Like most color management tools, Apple's ColorSync is based on the CIE XYZ model.

Eventually, Windows users will also get a built-in color-management system—in all likelihood a system that is based on the CIE XYZ model. But Microsoft has yet to make this a number one priority. The operating system developer says that it will focus on color management sometime after it ships Windows NT, which is currently due out this summer.

—Mary Kathleen Flynn

Top Retail Software

Current Ranking	Last Issue	Product/Company
1	2	Quicken for Windows 2.0 Intuit
2	3	QEMM-386 6.0 Quarterdeck Office Systems
3	7	Microsoft Access Microsoft Corp.
4	14	Stacker 3.0 Stac Electronics
5	4	Quicken 6.0 Intuit
6	—	Procomm Plus 2.0 Datastorm Technologies
7	5	Microsoft Windows for Workgroups 3.1 Microsoft Corp.
8	8	Microsoft Windows 3.1 Upgrade Microsoft Corp.
9	10	Microsoft Office for Windows 3.0 Microsoft Corp.
10	6	WordPerfect 5.1 for Windows WordPerfect Corp.
11	9	TurboTax ChipSoft
12	11	Microsoft DOS 5.0 Upgrade Kit Microsoft Corp.
13	1	WordPerfect 5.2 for Windows WordPerfect Corp.
14	—	PC Anywhere 4.5 Symantec Corp.
15	—	Microsoft Money for Windows 2.0 Microsoft Corp.

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending January 2, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

Portable Reader

FOR NEARLY 20 YEARS, VISUALLY impaired people have been able to buy computer-based electronic readers, but until now, the systems were all large, expensive, and stationary. Now Xerox Imaging Systems (XIS) has brought out the first portable reading machine.

At approximately 20 pounds and roughly the size of a briefcase, the Sun SPARC processor-based Reading Edge is much smaller than earlier reading machines. With a list price of \$5,495, it also costs less.

In 1975, Kurzweil Computer Products, now called Xerox Imaging Systems, created the first reading machine. It integrated

voice synthesizers with proprietary Intelligent Character Recognition (ICR) software in a 300-pound unit that was about the size of a washing machine. It sold for around \$50,000.

The portable Reading Edge uses XIS's ICR technology and Digital Equipment Corp.'s DECtalk speech synthesizer. It has a braille keypad that enables users to edit documents, and a so-called bookedge scanner that eases the chore of scanning books and other bound materials. With technology like this, visually impaired people are gaining better access to reading materials that everyone else takes for granted.

—Tin Albano

Disktop Publishing

HAND-HELD CD-ROM READERS ARE widely touted as the wave of the future for books. But the lowly floppy disk is also spawning a revolution in the publishing industry. There are now over 20 publishers putting books of all types out on disk instead of paper, and among them is Random House.

In collaboration with Apple and Voyager Co., the publishing giant has begun putting selected titles from its Modern Library series on floppy disks. Though these disks are currently available only in Macintosh format, other disk-top publishers—as this new breed is sometimes called—are targeting the PC-compatible market.

A particularly diverse selection is available from Floppyback Publishing International (201-963-3012). These range from poetry and classics to *The Angel of Death* by Bruce Gilkin (\$15), a novel about post-traumatic stress disorder from service in Vietnam. This publisher also offers some titles in conjunction with Rutgers University Press in New Jersey, including *Discovering the Mid-Atlantic: Historical Tours*, by Patrick Louis Cooney (\$20).

Another disktop publisher—Connected Editions (914-428-8766)—epitomizes the effect of information technology on higher education. This venture is the electronic publishing arm of Connected Education,

an “electronic college” that offers graduate courses by modem. Many of the Connected Editions titles are by faculty members and include fiction, visual poetry, and nonfiction such as *Evolution of Technology*, by David Hays (\$11.95). This last title is updated yearly, something prohibitively expensive to do with printed books but uniquely easy with work on-disk.

The disktop publishing market is being fueled by some unique advantages offered by the floppy disk. It's much cheaper to publish books this way than to print them, they can get onto the market much faster, and they can stay “in print” virtually forever.

Disktop publishing is especially appealing for universities. Putting scholarly monographs and textbooks on disk lets scholars and students avoid years of waiting for a book to get into print and makes the publications more amenable to the student budget. Hypertext footnotes and indexes and text-search engines can be invaluable for research.

The floppy disk format can be a boon for areas of publishing where readership is small or specialized, such as contemporary poetry. Since putting a book on a floppy requires only a small capital investment, a publisher can afford to bring out a book of poetry that would be a guaranteed money-loser in print format.

Disktop publishing also opens up an en-



The novel *The Angel of Death* is published on floppy disk.

tirely new avenue of distribution through shareware and bulletin boards. Many bulletin boards, including CompuServe, offer electronic publications for downloading. The Disktop Publishing Association's free bulletin board (205-854-1660) is an especially rich source of material.

—Robert Kendall

Patient, Heal Thyself

MULTIMEDIA PRODUCTS—SUCH AS IBM'S Thinkable, which helps rehabilitate head-injury victims, and the *Mayo Family Health Book* on CD-ROM, which educates home users on a variety of healthcare issues—have been helping to transform passive patients into informed consumers. Now a new interactive system from Sony takes shared decision-making a step further, promising to bridge the communication gap between doctors and patients.

Developed by Sony Medical Systems (800-535-7669) and the Foundation for Informed Medical Decision Making (a not-for-profit medical education and research organization based at Dartmouth Medical School), the Shared Decision-making Multimedia System is a series of interactive videodisk-based programs that help patients understand the details of their medical conditions and decide which treatment option is best. Current titles cover prostate problems, hypertension, lower back pain, and breast cancer.

"The use of computers in medicine has been moving rather slowly," says Dr. Albert G. Mulley, chief internist at Massachusetts General Hospital and a pioneer of the

project. "A parallel trend is patients becoming more involved in medical decision-making. The system is a merging of these two trends," says Mulley.

The hour-long interactive presentations enable patients not only to learn the facts about their condition and view animated diagrams of what's going on, but also to dig into the database for outcome probabilities

of various treatments based on history, symptoms, test results, and other personal data entered by the doctor. The databases draw on long-term healthcare studies that determine the effectiveness of various treatments and are developed in collaboration with the federally funded

Patient Outcome Research Teams (PORTS), located in academic circles around the country. Each session concludes with video interviews of patients who relate their first-hand experiences with different treatments.



Sony's interactive system helps patients and doctors share in decision-making.

Sony supplies a Dell 486SX with a Sony video overlay board, a Sony laserdisk player, a Sony touch screen, and an HP DeskJet 500 printer for \$7,995. The software is sold on a subscription basis—\$995 per program per year including updates.

To date, the programs have been used in 18 beta sites, including Blue Cross/Blue Shield and the Kaiser Permanente hospital in Denver, according to Sony. The first customers are expected to be the managed health care community and group practices. Although the primary purpose of the system will be to empower patients, it may also save on costs. In less than six months, one beta site saved \$200,000

on patients who opted out of surgery, according to Sony.

The Foundation has plans to develop up to 30 videodisks on a range of medical conditions, including coronary artery disease.

—Carol Levin

Briefs

DOWNSIZING CLEARLY HAD AN IMPACT

on the mainframe market, which shrank 16 percent last year, according to Dataquest's preliminary 1992 worldwide computer systems market share results. The move to client/server computing also contributed to the decline—and to the PC market's 7.4 percent growth.

NOT YET READY FOR PRIME TIME,

consumer-oriented technologies from IBM attracted large audiences at the Consumer Electronics Show in January, where IBM president Jack Kuehler gave the keynote address. Among IBM's demonstrations were NBC Desktop News, a customizable news service developed by IBM and NBC that is currently in pilot test; and Mega Pel, a 16-inch flat-panel color display with resolution approaching high-definition television. Another coming attraction

was the Multimedia WorkPad, a control center that will manage entertainment products (TVs, VCRs) and home appliances (air conditioners, microwave ovens). Shown at Fall Comdex, the WorkPad is a hand-held device with a color flat-panel touch-sensitive display.

MULTINATIONAL COMPANIES MAY SOON

find it easier to manage their PC-based global accounting systems, thanks to a new international consortium of resellers called the Accounting Systems International (ASI) World Group. ASI intends to provide global financial services comparable to those offered by mainframe accounting system vendors and the larger accounting firms, such as handling transactions in multiple currencies, meeting local reporting requirements, and consolidating multicountry ledgers.

—Mary Kathleen Flynn

Tandy

CONTINUED FROM PAGE 29

is expected to have a personal finance application that can interact with PC-based Quicken files.

The first Zoomer will be a small handheld device, and will mark the beginning of PC companies' inevitable osmosis into the potentially huge consumer market. Zoomer will take many of the technical innovations developed for PCs—such as a GUI-based operating system running from ROM, the PCMCIA socket, infrared file transfers, and off-screen hard icons that respond to the pen—and introduce them to a mass market where Tandy executives believe the buyer probably doesn't care that they are computers at all.

Not to be upstaged by the Tandy Texans, on the very next day Apple showed the first working prototype of its well-hyped Newton PDA. Apple, in partnership with Sharp, plans a family of products based on the Newton technology with the first product due out at midyear, just ahead of Zoomer.—Christopher Barr

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—PC Magazine, January 26, 1993

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—PC World, February 1993, BEST BUY

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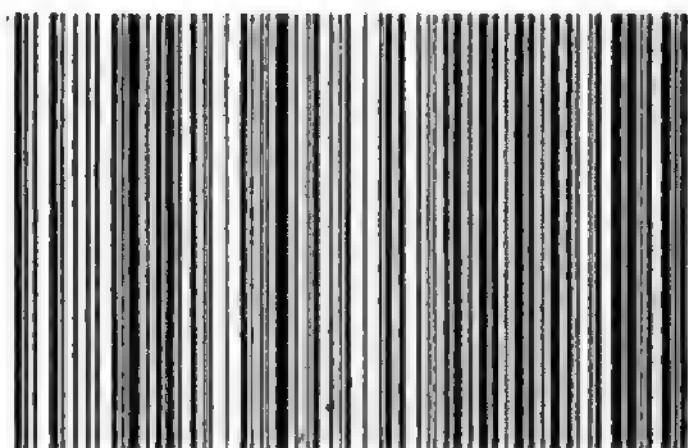


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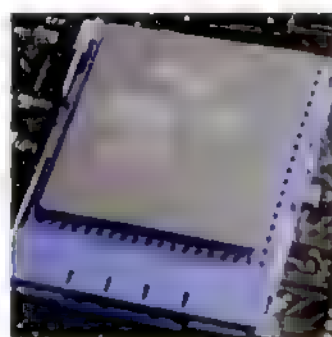
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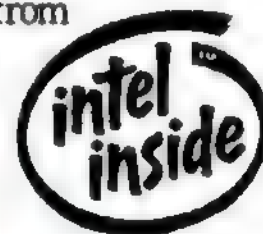
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Y/N How Many?

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ Windows Databases

Paradox for Windows Features Graphical Ease of Use

BY WILLIAM BEEM

Now that the long wait for Borland's Paradox for Windows is over, you can see why it took so long to deliver. Borland has completely redesigned Paradox to take advantage of the Microsoft Windows interface and environment.

The result is an attractive relational database that fits well into its new environment. Users of Paradox for DOS won't recognize the menus, but the power and functionality of Paradox is still there beneath the interface. This \$795 program (\$139.95 through April 30) is the best implementation of Paradox yet.



GRAPHICAL PARADOX: Developers can create attractive graphical applications.

Paradox for Windows provides an event-driven, object-oriented, visual drag-and-drop development environment that

is fine for easing novices into programming, but it still retains great power and flexibility for advanced programmers.

Unlike Microsoft's \$495 Access, which seems targeted at a broader range of less experienced database users, and whose programming language is a dialect of BASIC, Paradox for Windows embraces all the sophistication of its previous DOS ver-

sions. The news is that it does so while dressing up all that power in a well-designed graphical interface.

On the output side, the program's graphical reporting features really shine. With the combination of Windows fonts and graphical images, output can be as dazzling as any screen image. In fact, screen forms can be opened and printed as reports.

INSIDE THE DATABASE DESKTOP

The Database Desktop, Paradox for Windows' user interface, treats data and information about the data—font, color, formula, or relationship to a table—as a single object. For example, Table objects contain both data elements and the processes that manipulate the data.

Though the implementation of object-oriented programming (OOP) in Paradox for Windows is less rigorous than in Borland's C++ or even in Borland's Pascal, OOP does make application development much easier.

You can manipulate objects such as tables, queries, and reports, although they can't define new object classes or
Continues on page 38

■ Document Management

Pinnacle Micro's Paperless 1 Puts Paper in Its Place

BY GREG PASTRICK

It's not easy being green in the office, but Pinnacle Micro's \$6,995 Paperless 1 imaging system makes it possible to cut back significantly on office paper consumption and on storage space as well.

The Paperless 1's imaging and file management capabilities make hundreds of megabytes worth of scanned paper-born documents available to networked groups of all sizes. The system integrates scanning and optical storage technology with Windows-based applications to store, retrieve, and dis-

tribute documents across Net-Ware 3.11-compatible networks. And it does all that in a way that's plainly task-oriented and acutely focused.

On the hardware end of the Paperless 1 system, Pinnacle Micro teams a pair of SCSI devices to capture and store paper input. For capturing documents, it uses a 400-dot-per-inch flatbed gray-scale scanner with 4-bit-per-pixel scanning capabilities. With no external scan controls for the Ricoh engine, this minimalist, turquoise-accented flatbed unit has an 8.5- by 14-



PAPERLESS 1: The \$6,995 system includes a scanner and an optical drive.

inch scan area and comes with a top-loading automatic document feeder that's able to handle up to 30 pages.

Scanning controls in the Paperless 1 software offer little more than its hardware controls.

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First Looks

Paradox

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create descendant objects. You can embed buttons and other objects in data entry forms, a form of encapsulation. And encapsulated objects can inherit any changes to properties made to the host object, a form of inheritance.

Polymorphism is addressed by modifying the methods that affect an object's behavior. For instance, a button object knows only that it can be pressed and display a label. In order for this button to have an action, such as moving to the next record, you have to define the action using the command from the ObjectPAL programming language. This gives each of the objects in Paradox for Windows a great deal of individual flexibility.

Another component of the Desktop is the Object Inspector—Borland's method of displaying context-smart menus. Point at an object

on the screen, such as a table, click the right mouse button, and a list of configurable properties specific to that object will pop up.

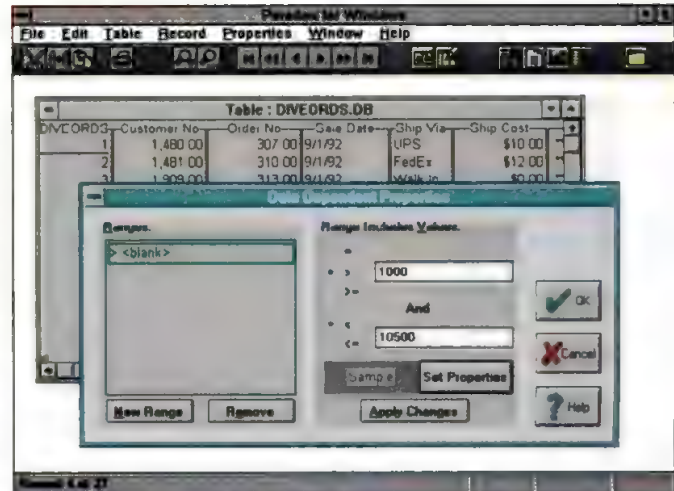
Like the Object Inspectors, speed bars are also context-sensitive and are available from any point in the program. For example, when you open a table, the program automatically adds icons for searching, printing, traversing the file, and setting up quick reports, graphs, and forms. The many new context-sensitive menus follow Windows guidelines, but they may confuse some users of the DOS version at first. The "Ask" menu choice for initiating a query, for example, simply doesn't exist under Paradox for Windows.

CONNECTING TO THE INTERBASE ENGINE

Under the hood, Paradox for Windows runs the Borland InterBase engine, which allows transparent access to a variety of data formats. You can perform the same operations on native Paradox or .DBF files, in-



To download information on Paradox for Windows from PC MagNet, type GO ZNT:EXEC. from any CompuServe prompt. From March 8 through March 12, you can go on-line to discuss Paradox for Windows with William Beem and Borland vice president Rob Dickerson. Type GO ZNT:EXEC in CompuServe.



FINE CONTROL: Object Inspectors help you set characteristics.

cluding queries combining the two formats, and that lets you preserve the investment you have in your existing data. It's also possible to enhance performance for certain operations by choosing the file format that best handles the task.

At this time, Paradox for Windows supports only Paradox .DB and dBASE .DBF files. Borland intends to release Borland SQL Link to address remote file access. Connections will include access to InterBase, Oracle, and Microsoft/Sybase files.

The InterBase engine will also support data access drivers

as Borland releases them. Third-party supporters for the InterBase drivers include IBM, Delrina, Gupta, Novell, WordPerfect, MicroFocus, and others. The .DB file-format is compatible with Paradox 4.0 for DOS and Borland's Paradox Engine 3.0 products, but it can still take advantage of Windows features.

Borland went all out in supporting field types. Some of the new data types are implemented as binary large objects (or BLOBs), which opens up Paradox files to the world of video images and sounds.

Object linking and embedding (OLE) fields can implement any data type as long as a corresponding OLE server program exists to edit them. Formatted memo fields can include various fonts, colors, and styles. Graphic image fields can support .BMP, .EPS, .GIF, .PCX, .TIFF, and Windows Clipboard files.

Although less exciting, Paradox for Windows finally implements the logical (yes/no) field type.

APPLICATION DEVELOPMENT

With ObjectPAL, Borland has redefined the old PAL language. Applications are developed by creating objects, modifying their behavior, and linking them together. Developers can use a traditional menu bar or

Performance Tests: Paradox for Windows

Paradox for Windows proved to be slower than Paradox 4.0 for DOS on the loading of tables. Although the indexing time was faster than that of the DOS version, we experienced a "Divide by zero" error during the creation of one of the secondary indexes, which caused our test machine to lock up. After rebooting, the index was created successfully. The results for both the numeric and alphanumeric Select tests were very close to those of Paradox 4.0, but the secondary index, which was present on the alphanumeric field, was of no use to Paradox since the result set exceeded the threshold of beneficial performance gain for both versions. Performance on the Join test was on a par with that of Paradox 4.0 and FoxPro 2.0.

We evaluated Paradox for Windows' performance by running a series of tests interactively using its native file format as well as attached dBASE IV data and index files. We ran all tests on a Compaq Deskpro 386/25M equipped with 8MB of RAM.

The **Load and Index** tests measure the time it takes to import four 100,000-row tables from an ASCII file and create 13 indexes.

The **Select** test measures the time it takes to search indexed numeric and alphanumeric fields, returning 10 percent of the table as a result.

The **Join** test measures the time it takes to perform a join on three tables via a numeric primary key field.

Lower scores represent better performance.	Load (seconds)	Index (seconds)	Select (numeric) (seconds)	Select (alphanumeric) (seconds)	Join (seconds)
FoxPro 2.0	1.634	680	1	11	2
Paradox 4.0 for DOS	5.507	1.913	5	27	1
Paradox for Windows	7.398	1.376	8	29	3

First Looks

form buttons to select application choices or launch other forms, queries, and reports. The connections between these objects can be graphically displayed in tree form, a real Windows advantage.

ObjectPAL offers two types of methods: built-in and custom. Built-in methods are preexisting methods that direct the way objects respond to an event. Button objects, for instance, have a PushButton. When the button is clicked with a mouse, the Push-Button method is executed.

Custom methods are developed by the programmer. Instead of responding to events, these methods are called by built-in methods to perform a specific task, such as a function to calculate totals.

Programming code in ObjectPal now includes structured variables and records and is starting to look quite a bit like Pascal. These types have existed in the C/Pascal/BASIC world for a number of years, but have been conspicuously missing from traditional database development languages. Records may contain one or more fields of any supported data type, and may contain Key information.

Borland has successfully created a programmer's database that offers all the ease-of-use amenities that nonprogrammers need. The powerful Database Desktop, robust InterBase engine, and reworked ObjectPAL programming language keep Paradox for Windows at the forefront of the database market.

• **List Price:** *Paradox for Windows, Version 1.0*, \$795 (introductory price of \$139.95 from February 1 through April 30); upgrade, \$139.95. Requires: 4MB RAM, 12MB hard disk space, Microsoft Windows 3.0 or later. Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; 800-331-077, 408-438-8400; fax, 408-439-9119.

Circle 423 on reader service card

Paperless 1

CONTINUED FROM PAGE 37

From a simple setup menu within the system's Scan application, you only have access to contrast and brightness controls over the scanner's 256 gray-scale capabilities. Enabled resolutions range from 120 to 300 dpi, but Pinnacle Micro is considering adding 1-bit scans and full 400-dpi in future updates.

For mass storage and retrieval, the Paperless 1 uses Pinnacle Micro's own PMO-650 magneto-optical drive, which is able to store up to 595MB, or 298MB per side, on its 5.25-inch cartridge. With an average access time of 46 milliseconds posted on our DOS Disk Access benchmark test, the drive delivers close to ESDI-level performance in data transfer (First Looks, September 29, 1992).

SOFTWARE SOLUTIONS

Both devices hang off a Future Domain SCSI-2 adapter card and are driven by Pinnacle's Paperless 1 Windows-based software. As an integrated document-management solution, you'd be hard pressed to find any other Windows software that's as strictly defined and pointedly purposeful as the Paperless 1's software is.

From Windows' Program Manager, you have a selection of four task-oriented applications to choose from, depending on your assigned rights.

Base rights allow anyone named on the system to scan documents in, retrieve them, or send mail-referencing documents stored on the magneto-optical drive. Template design or Paperless 1 administration privileges can also be assigned to named users, as can password requirements for system access.

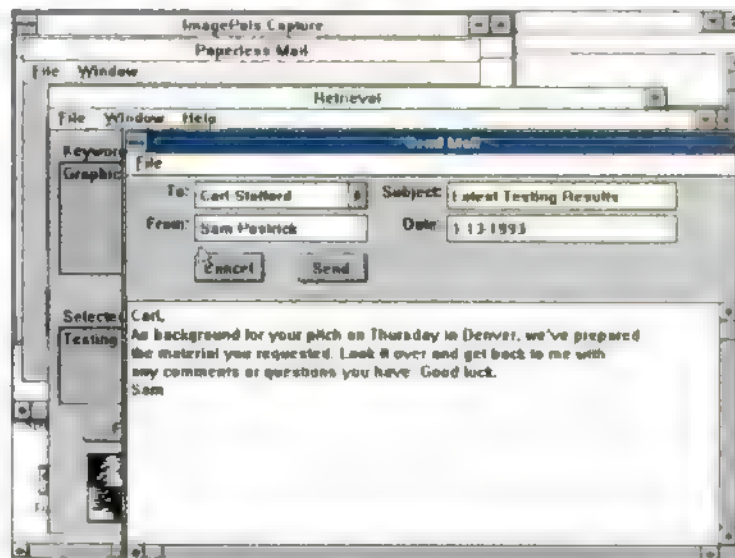
By design, the Paperless 1 system and its applications are restricted to primary functions: filing and looking at documents. Documents that are stored in image files on the magneto-optical drive are not intended to be manipulated. They exist only to be read, passed along, or printed. While you have the capability to print other Windows application files to the Paperless 1 system, like scanned input, all files are saved to Run Length Encoded (RLE) compressed bitmapped format.

RLE bitmap files don't have the level of compression of .LZW file formats, but the compression does help to keep image files with large amounts of white space down to reasonable sizes.

FILING SYSTEM

The Paperless 1 filing system is designed around a file cabinet metaphor, with documents or images grouped and stored individually or together in assigned folders. For example, collected invoices can be stored and referenced to an invoice template that can be built with a selection of entry field types and attributes.

When a document is stored, information about the docu-



PAPERLESS MAIL: One of the included apps.

ment or picture needs to be entered on a template for it to be filed correctly. The system then uses keywords in the template entry fields as references for fast retrieval and multiple user distribution across the Paperless Mail network.

Template design privileges let selected users and the admin-

PAPERLESS 1

Paperless 1
Pinnacle Micro Inc., 19
Technology Dr., Irvine, CA
92718; 800-553-7070; 714-727-
3300; fax, 714-727-1913

List price: With PMO 650 optical disk drive, 5.25-inch writable optical disk, 400-dpi gray-scale scanner, top-loading automatic document feeder, 16-bit SCSI-2 host adapter card, two SCSI cables, two power cables, \$6,995

Requires: 2MB RAM, 1 MB hard disk space, Windows 3.0 or later.

In short: An effective though somewhat expensive document imaging and management solution that combines a scanner, magneto-optical drive, and proprietary software

422 ON READER SERVICE CARD

istrator create a finely tuned file system for storing single or grouped documents and images. Basic design elements for template creation include labels, field types, and field attributes for keywords. Field types include letters, numbers, dates, and file cabinets, which enables a scrolling list of file cabinets on the system.

Template field attributes include locked, required, invisible, and expandable (scrolling) keyword fields, and standard field sizes are limited to 31 characters. Like all the Paperless 1 applications, the interface is easily mastered.

Pinnacle's Administrator application exists primarily to manage users and their access privileges across the system. However, the administrator has access to the full functions and features of each Paperless 1 application.

DOS and Macintosh versions of the Paperless 1 system are due to be released soon, but Pinnacle Micro's decision to go with Windows first was a smart move. The fact that you can have an effective paperless filing system installed directly on LAN servers or selected workstations along the network is Paperless 1's best selling point. □

■ Data Compression

PKZIP Now Faster, More Efficient

BY BARRY SIMON

Even with the growing popularity of on-the-fly data compression programs such as Stacker, nothing beats batch archiving compression for sending data over the wire. That's why it's significant when PKWARE releases a major new version of its \$47 shareware classic, PKZIP.

FILE DEFLATION

PKZIP, Version, 2.04, uses a new compression type called "deflating." The results: PKZIP 2.04-compressed files were typically 5 to 15 percent smaller than PKZIP 1.1-compressed files, and the program performed up to 30 percent faster.

Before this upgrade, PKZIP was slightly less efficient in compression than its closest competitors—ARJ (Robert K. Jung, 2606 Village Road West, Norwood, MA 02062; \$40 as shareware) and LHA (see LHA213.EXE on PC MagNet's

Util Forum; free). This new version of PKZIP manages to edge them out, except when the archives hold lots of small files. In such cases, ARJ is marginally better.

The price paid for the new, more efficient method is incompatibility. PKZIP 2.04 will decompress .ZIP files made with earlier versions of PKZIP, but if you try to use the old PKUNZIP on a new .ZIP file, you'll get the message: "I don't know how to handle: <file-name>." So, for months to come, people will be asking "By the way, do you have Version 2.04 of PKZIP?" before they send you a file. So you'll need to keep the old version around to make .ZIP files compatible with Version 1.1. There's no way to tell PKZIP 2.04 to make a 1.1-compatible .ZIP file.

PKZIP and PKUNZIP will use expanded and extended memory if available, make use of 286- and 386-specific code if they discover a compatible CPU, and run 32-bit code if they

find a DPMS (DOS Protected-Mode Interface) server such as that found in DOS sessions run from Windows. (PKWARE acknowledges problems with DPMS on some systems.) These improvements, plus swifter algorithms, account for the program's newfound speed, now comparable to that of the historically faster ARJ.

.ZIP file decomposition times were always blazing, often twice as fast as the competition, and Version 2.04 still holds that advantage. The program has also added so many new options that its single-screen feature summary has grown to four screens.

SPANS FLOPPIES

One of the more interesting features is the ability to have a .ZIP file span multiple floppy disks, but this feature is not nearly as well implemented as in ARJ. You have to shuffle the first and last disk into the drive when unzipping. If you select the option that formats the disk while zipping, there is no protection from

using the same disk twice. And, if you use the formatting option and use a disk with bad sectors marked on it, PKZIP will blithely use the bad sectors.

There are many small bugs that PKWARE expects to fix in a maintenance release. For example, you can't zip files on drive A to a .ZIP file on drive A. And while PKZIP will grab available HMA or UMB space when it loads, the program neglects to release it upon exiting.

With the release of Version 2.04, PKZIP remains the data compression standard and has successfully kept up with ARJ, which had just about overtaken it. If you use PKZIP 1.1, you'll want to upgrade, but watch out for the hassles as you try to cope with others who haven't yet upgraded.

• List price: PKZIP 2.04, \$47. Requires:

256K RAM, DOS 3.2 or later. PKWARE Inc., 9025 N. Deerwood Dr., Brown Deer, WI 53223; 414-354-8699; fax, 414-354-8559.

Circle 418 on reader service card



PKZIP 2.04 is available as shareware on ZiffNet. Type GO:ZNT:EXEC from any CompuServe prompt. From March 1 to March 5, you can go on-line to discuss PKZIP with Barry Simon and PKWARE representatives. Type GO ZNT:EXEC.

Performance Tests: PKZIP, Version 2.04

We tested PKZIP 2.04 and PKZIP 1.1, timing how long each took to compress four sets of files on a 25-MHz 386 with 8MB of RAM. The **text files** were a combination of word processing files and ASCII text. The **data files** were a mix of .WK1 and .DBF files, and this batch included 43 small files (1.5K to 10K). The **graphics files** consisted of vector and bitmapped files, including several in already compressed formats (.GIF and compressed TIFF). The **Windows** mix was the 4.5MB of files found in the Windows directory after a fresh installation of Windows 3.1; it included text, graphics, .EXE, and .WAV files.

In just about all cases, no matter how it was optimized, PKZIP 2.04 was faster at compressing files than PKZIP 1.1, stumbling only on the graphics files. The new version also shows improved overall compression, coming in with percentages that keep it competitive with the ever-improving ARJ and LHA. (For each group of files, the **compressed file size** is expressed here as a percentage of the uncompressed file size. A 1,000K file compressed to 40 percent would be a 400K compressed file. Smaller percentages mean better compression.)

	TEXT FILES		DATA FILES		GRAPHICS FILES		WINDOWS FILES	
	Compression Time (seconds)	Compressed File Size (percent)	Compression Time (seconds)	Compressed File Size (percent)	Compression Time (seconds)	Compressed File Size (percent)	Compression Time (seconds)	Compressed File Size (percent)
ARJ (optimized for file size)	38.9	28.8	18.2	31.0	42.0	84.2	382.0	47.9
ARJ (optimized for speed)	14.7	33.9	7.6	34.7	8.1	87.6	115.0	53.2
LHA	42.6	30.2	12.2	30.7	38.9	84.2	251.0	48.4
PKZIP 2.04	18.2	29.0	6.0	31.7	29.4	29.0	156.0	47.9
PKZIP 2.04 (optimized for file size)	28.1	28.7	8.2	31.7	40.7	84.1	232.0	47.7
PKZIP 2.04 (optimized for speed)	11.0	33.7	4.2	33.9	17.4	85.3	75.7	52.1
PKZIP 1.1	32.5	32.2	16.1	34.3	24.4	87.6	295.0	51.0

Lower scores represent better performance.

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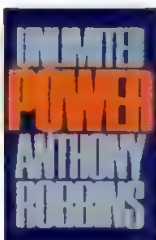
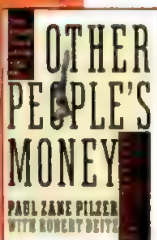
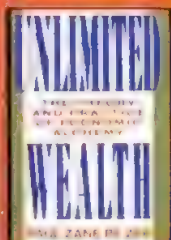
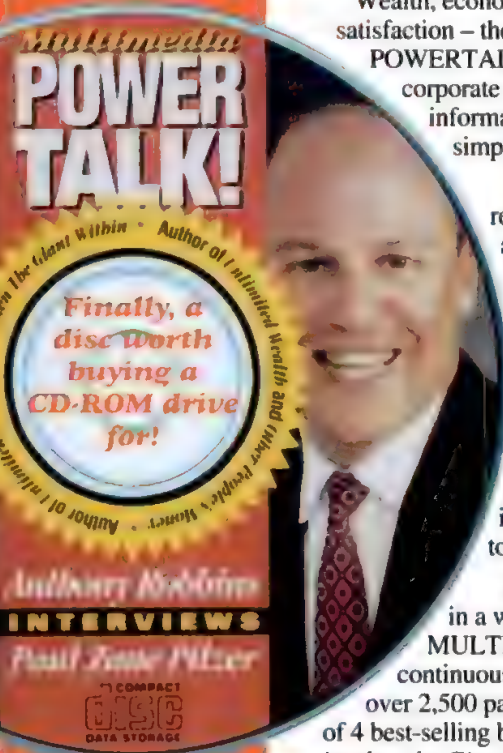
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■ Windows Database

Superbase 2.0: A Good Home For Database Developers

BY RON ANDERSON

Superbase, Version 2.0, the latest release of Software Publishing Corp.'s (SPC) \$795 database, is a winner from start to finish. Superior interface design, graphical database creation and maintenance tools, sharp editing and development tools, and a powerful programming language make this package a great choice for serious Microsoft Windows database applications developers.

Though Microsoft Access and Borland's Paradox for Windows (see page 37) are making headlines on the Windows database scene, Superbase has been running under Windows since 1989 and has been keeping, if not setting, the pace ever since. From a Windows database developer's standpoint, SPC's (and formerly Precision Software's) three-year head start shouldn't be overlooked. Version 2.0 is proof that SPC has been anything but idle.

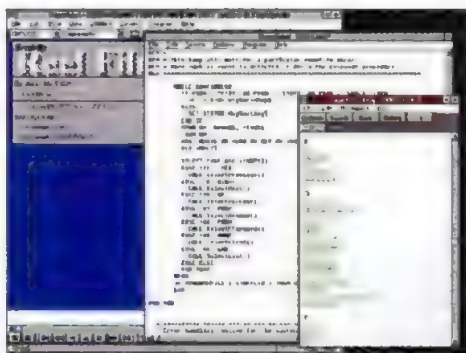
Developers and end users alike will be pleased with the powerful tools included in Superbase. SPC has taken Windows' point-and-click visual interface and incorporated it into every important aspect of database management, from creating data files to inserting, editing, updating, querying, and reporting their contents. In fact, one of the best new features is the icon-based query-by-example (QBE) interface.

BETTER PROGRAMMING

Developers will like the enhancements to the program editor and to Superbase's programming language, Super Basic Language (SBL). Of particular note is the ability to look up and paste commands, expressions,

and field names into code.

The program editor also performs elementary syntax checking. The built-in program debugger gives developers program-execution control, break points, variable checking and dynamic alteration, and a history function.



GUI DESIGN: The environment lets you design queries, forms, reports, even entire apps.

SBL incorporates support for user-written procedures and event-driven programming. Because you can take advantage of "top down" programming techniques, your code will be easier to debug and maintain. The library of procedures has also been enhanced. More than 100 functions are incorporated, including a COMM procedure that provides serial communications and Xmodem file transfers.

SPC has made migrating databases and applications from Version 1.3 to Version 2.0 as painless as possible, while incorporating significant improvements. You now have complete control over the look and feel of your applications through interactive dialog boxes, an icon bar, and menu editors that are as easy to use as they are powerful.

The updated Forms Designer and Report Designer are more Windows-compliant than

they were in the previous version. For example, you no longer select an object with the right mouse button. Instead, you use the pointer tool and click the left button. Additionally, the Forms Designer produces code that you can incorporate into your SBL procedures.

Superbase includes support for Window's Dynamic Data Exchange (DDE) as a client and server, Object Linking and Embedding (OLE) as a client, and extensibility through dynamic link libraries (DLLs). Superbase supports DLLs by calling C functions within the DLL directly. You must be familiar with C programming and have an intimate knowledge of the C functions that are contained in the DLL to make use of this feature.

In multiuser environments, Superbase supports some elementary data access and security features. Developers can maximize data concurrency through file and record locking while ensuring that different users are not working on two different versions of the same record within the database. Data files can be password-protected to give users varying data-access rights.

You can create a data file that allows some users read/write access, while others have only read access or no access at all. Ambitious developers can write more elaborate security measures, but these efforts will always be limited by the fact that they are add-ons and not

enforced by the engine itself.

Superbase has what it takes to fit into your current corporate structure. The program reads and writes directly to .DBF files and can import and export Paradox data. With the addition of the Superbase SQL library, Superbase applications can connect to corporate-wide SQL relational database-management systems including DB2 (through MicroDecisionware's Gateway), Oracle Server, SQLBase from Gupta Technologies, SQL Server from Microsoft, and XDB Systems Server.

TWO VERSIONS

Superbase comes in two different flavors: the \$795 standard version and the \$1,395 Developers Edition, which includes Superbase, SQL Library, the Superbase Runtime System with unlimited rights to copy and distribute your applications, and one additional user license.

Superbase provides database programmers with an integrated Windows database application-development environment that is second to none. The enhancements in Version 2.0, and the superior integration of the package's components give you everything you need to write sophisticated applications. □

FACT FILE

Superbase, Version 2.0

Software Publishing Corp.,
3165 Kifer Rd., P.O. Box
54983, Santa Clara, CA 95056;
408-986-8000;
fax, 408-450-7915

List Price: \$795, Developers Edition, \$1,395, SQL Library, \$495, upgrade, \$149, competitive upgrade, \$199.

Requires: 2MB RAM (4 MB recommended), 5MB hard disk space, Microsoft Windows 3.x.

In short: Better report design and generation and improved import and export of data make the new Superbase a good choice for Windows database developers.

428 ON READER SERVICE CARD

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Document Management

PageKeeper Stores And Retrieves Any Document

BY GREGG KEIZER

Take huge hard disks, add a slew of scanners, toss in scores of fax boards, connect with a network, and before you know it, you're drowning in documents. Having too much information can be as hard on the bottom line as not having enough—that is, if you can't locate the information when it's needed.

Caere Corp., best known for its line of optical character recognition (OCR) software, thinks its PageKeeper document-management software is the solution. Assuming you can justify its \$895 price, you'll probably agree.

PageKeeper may be tough to categorize—by turns it's an OCR package, a rudimentary e-mail program, a text-retrieval system, an image cataloger, and a database—but its significance is perfectly clear. This Microsoft Windows application is a brilliant piece of software that organizes, searches, and retrieves documents, no matter what their original form.

Because PageKeeper includes Caere's OmniPage OCR engine, it handles paper, not just the electronic documents already on your hard disk or network. Without leaving an application, you can scan images and text using a variety of supported scanners, including models from Apple, DEST, Epson America, Hewlett-Packard, and Microtek.

Though PageKeeper's OCR abilities aren't quite up to the

standards of OmniPage Professional, the results are almost as impressive, with few recognition errors even when the originals are newspaper clippings with small type. Before finishing a scan job, PageKeeper indexes text documents, adds them to its own database, and stores both image and text-only versions.

You can also import a variety of file formats—ranging from .PCX and TIFF to many word processing formats—into PageKeeper's database, a technique you'll use to digest incoming fax image files. Scanning, OCR recognition, and indexing can be set up to process in batches, a boon if you're bringing in several documents.

Existing documents, for example, word processing or e-mail files, can also be indexed and then retrieved by a PageKeeper search. Such files can be on local or remote drives. Indexing, the process PageKeeper goes through to ready a

files, of which only two dozen were either new or changed, took more than half an hour.

NEEDLES IN HAYSTACKS

For all of PageKeeper's prowess in assimilating information, the program is even more dazzling when it searches its database for relevant documents. Three types of searches—weighted word, Boolean, and document agent—generate lists of pertinent documents. The lists are color-coded: Red means a docu-

PageKeeper, Version 1.0

Caere Corp.; 100 Cooper Ct.,
Los Gatos, CA 95030;
800-535-7226, 408-375-7000;
fax, 408-354-2743

List price: \$895; 5 users, \$1,995.
Requires: 4MB RAM (8MB recommended), 10MB hard disk space, Microsoft Windows 3.1.
In short: PageKeeper may be expensive, but it has no peer when it comes to acquiring, storing, and retrieving documents of all kinds, from paper-based text to electronic image files.



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ment is highly relevant, green means one is less so, blue indicates one is even less likely to be of interest.

The results are almost spooky. In test after test, whether culling documents from scores of scanned newspaper articles or from more than 300 Microsoft Word for Windows files on multiple drives, PageKeeper invariably posted exactly the desired document either at the top of the list or colored red.

The three search forms offer plenty of flexibility. The weighted word search gives almost complete control to PageKeeper's intelligence. The document agent search, however, lets you explore the database using a previously located

document as a type of template. It's an interesting way to dig up similar documents.

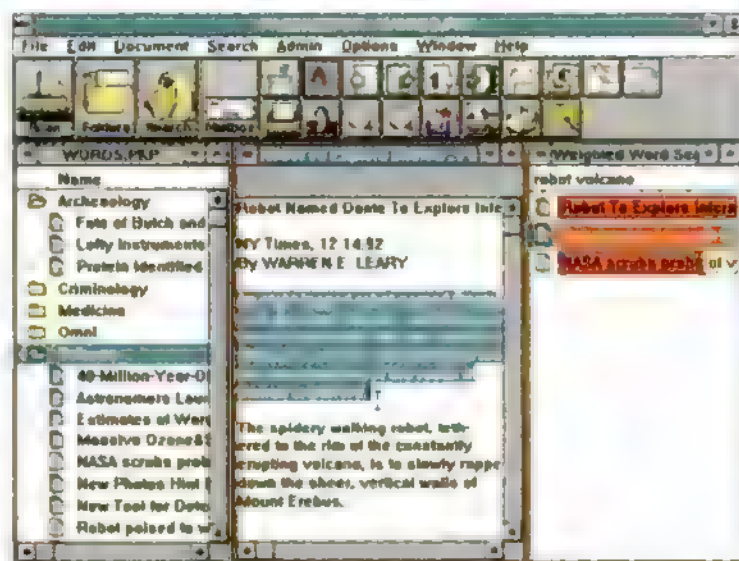
Network users of PageKeeper can quickly post documents to each other through the program's e-mail system. Though PageKeeper won't replace a dedicated e-mail package—you can't edit a document within the program, for instance—you can attach files to messages, then send both to another user.

Single-user installation may be a snap, but putting PageKeeper on a network can be time-consuming. Network users must share a transaction file and use identical drive mapping for any remote drives housing external files in a PageKeeper database. Careful consultation with the documentation will see you through the process. In testing, PageKeeper worked well on a Windows for Workgroups network.

Some minor quirks of PageKeeper appear occasionally. You can't quickly scroll a multipage document, nor can you select an entire document from the keyboard for cutting or copying. And though the inclusion of scanned documents' image files may be useful for reference purposes, there's no fast way to delete these large files.

PageKeeper puts some heavy demands on your hardware as well. Not only does the program use substantial amounts of Windows system resources, but it struggles with anything less than 8MB of memory. Even then, a generous swap file—at least 10MB—is necessary. And the program's high price may be hard to justify unless your document-management needs are clear-cut.

Even so, PageKeeper is an outstanding addition to a network or packed hard disk when documents abound. Its ability to acquire documents of all kinds, then go out and identify just the right one, easily puts it at the top of the list when you're looking for a document manager. □



MASS STORAGE: PageKeeper's multiple windows hold a wealth of information.

file for later searching, is relatively slow, and for all but the smallest groups of files, it's best saved for overnight processing. Reindexing a database of 250

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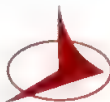
solutions—and let you communicate clearly with everyone connected to the job.

Software to keep your crew in sync, even in the roughest waters.

Primavera is fully multiuser. All members of your team can work on any parts of the same project—or group of projects—simultaneously. It's one more reason why Primavera Project Planner is the software of choice for thousands of projects around the world.

The video is FREE. And so is the call.

Contact Primavera at 1-800-423-0245 for more information and a free video presentation about Primavera Project Planner. Do it today—for better project control tomorrow.



CIRCLE 148 ON READER SERVICE CARD

PRIMAVERA

How the world says project management

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Database Report Writers

\$495 Reportsmith: Point and Click for Reports

BY RON ANDERSON

If you have spent countless hours counting column positions and writing hit-or-miss code to produce database reports, Indigo Software Corp.'s \$495 Reportsmith, Version 1.0, may be what you're looking for. Reportsmith produces stunning reports from your database files interactively, using a WYSIWYG approach to report formatting that makes designing a layout a simple point-and-click experience. You can forget about column counting.

And Reportsmith's scope is far-reaching. It can access data from today's most prevalent data sources, including dBASE, Excel, and Paradox files; server-based Btrieve files; DB2 files

cause reports are created interactively, you can filter and sort data, add derived or calculated fields, change the order of fields, or group data at any time during the session. Reports default to a columnar style, and you can create form and crosstab reports as well.

Reportsmith gives you control over the font, size, shape, placement and color of the text in your report. It also allows you to place graphics, charts, and drawings in strategic locations to highlight your data. Drawing tools are included.

All of this interactivity encourages experimentation with various report layouts, as long as you're willing to wait for the report to reformat. Even on a 33-MHz 486 system with 16MB of

RAM, some operations proved too slow. Of course, when you consider the time that you are saving over other database reporting methods, an occasional pause seems more than bearable.

Once a report is formatted just the way that you want, you can

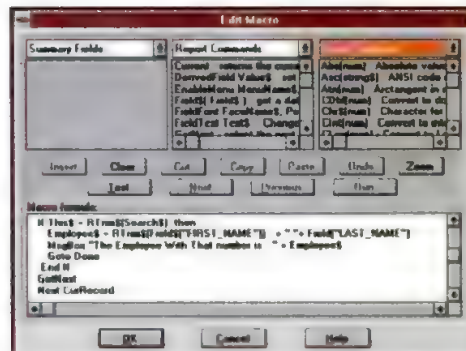
save and reuse it. Since the data in a Reportsmith report is not saved with the report, changes to the data will be reflected in the report each time you run it.

WIDE RANGE OF USES

Reportsmith is tailored to fit the needs of a variety of users, from casual users who need quick information in a presentable format to MIS personnel charged with producing up-to-the-minute business reports that

smith's ReportBasic, a BASIC-like programming language for writing macros to automate Reportsmith sessions. Virtually every aspect of Reportsmith's operation can be controlled by macros. A generous selection of statements, functions, and branching and looping logic is included. If you're so inclined, macros can be written using a point-and-click procedure, or you can write the old-fashioned way by typing statements line-by-line.

As for the SQL language, Reportsmith lets you look but not touch. If you do not know SQL



CUSTOMIZE: You can write macros with the ReportBasic programming language.

guide corporate-wide decision making.

Casual users can take full advantage of the WYSIWYG display, the point-and-click interface, and the interactive design to produce reports as they're needed. In fact, anyone familiar with a Microsoft Windows word processor or spreadsheet already has most of the skills necessary to produce and format reports because of Reportsmith's adherence to a standard Windows user interface.

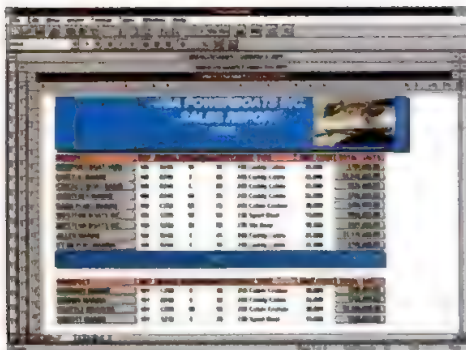
More sophisticated users can take advantage of Report-

programming, and the language stands between you and your data. Reportsmith can be a god-send because you're completely protected from the intricacies of SQL programming. But for SQL experts, that protection may be a little too complete. Reportsmith tantalizes by letting you view the SQL statement that it is using to select and order your data, but you can't edit the statement directly.

INFORMATION PLEASE

To make full use of Reportsmith, you'll need to spend some time learning its ins and outs. Unfortunately, while the point-and-click interface is great for casual users, Indigo hasn't done enough to help the novice database publisher over the rough spots. For example, the Getting Started Guide attempts to walk you through the basics of creating a report using screen shots and examples from a database file that isn't even included as one of the samples.

As it stands now, Reportsmith is a well-designed and very usable (though somewhat expensive) addition to your database utilities toolbox. It's definitely taking database reporting in the direction it needs to go. □



DATA ACCESS: Creating visually stunning reports is easier than ever.

(through MicroDecisionware's OS/2 gateway); and Ingres, NetWare SQL, Oracle, SQL-Base, SQL Server, Sybase, and XDB tables.

A Reportsmith session begins with identification of the data source, whether it's a local file or data coming via a connection to a database server on the network. Multiple files or tables of the same type can be opened simultaneously and joined. Be-

FACT FILE

**Reportsmith,
Version 1.0**

Indigo Software Corp., 2755
Campus Dr., #205, San Mateo,
CA 94403; 800-446-3446, 415-
312-0770; fax, 415-312-9014

List price: \$495
Requires: 4MB RAM, 8MB hard disk
space, Microsoft Windows 3.1.
In short: This WYSIWYG database re-
port writer makes data display easy. It
has wide-ranging data-access capabili-
ties, and you can redesign reports on
the fly with little fuss.

ON READER SERVICE CARD

It goes every place. Even first place.



With so many notebooks to choose from, suddenly everything has fallen into place. *PC/Computing* has just named the IBM ThinkPad™ 700C their 1992 Color Portable MVP. Not COMPAQ®. Not Toshiba®.

In fact, ThinkPad has so much going for it, they said the 700C was "an easy choice for MVP." They also said ThinkPad "comes with one of the shrewdest keyboard layouts available" and with TrackPoint™ II, a built-in mouse that "offers better control than just about any we've seen."

But don't just take their word for it. For more information or an IBM dealer near you, call 1 800 772-2227. In Canada, call 1 800 465-7999. Compared to other color notebooks, ThinkPad is everything you were looking for in the first place.

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■ Multimedia

Orchid Does Sound Both With and Without Video

BY TIN ALBANO AND
MATTHEW J. ROSS

Orchid Technology has followed in the footsteps of one of its largest competitors, ATI Technologies, by venturing outside the fiercely fought over video market and into the sound arena. With its \$199 Sound Producer Pro, Orchid provides a moderately priced board to satisfy both game players and the business-minded. And the \$299 Fahrenheit VA video board combines Windows video acceleration with some of the same sound features.

SOUND PRODUCER PRO

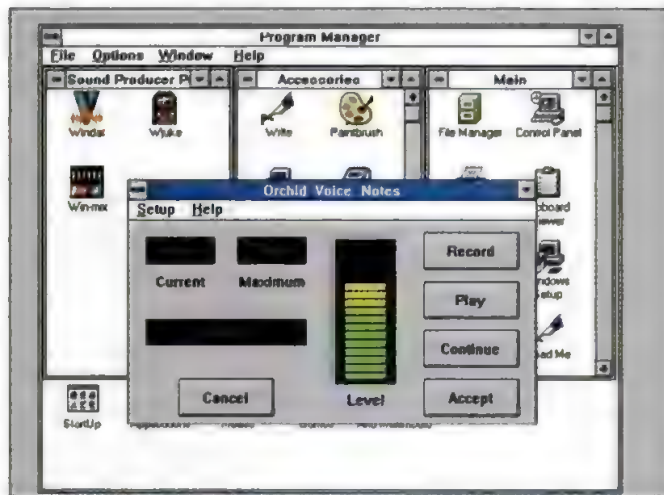
Though the Sound Producer Pro carries a list price of \$199, it will probably sell for about \$70 less, a competitive price for a technically competent if unspectacular 8-bit sound board that delivers the right combination of features for the growing Windows-based business market. Those features include a lapel-type microphone, two 5-inch mini-speakers, and common third-party sound software for mixing, recording, voice annotating, and playing audio CDs.

The Sound Producer Pro is a 16-bit ISA expansion board that features an 8-bit Aztec FM synthesis sound chip and DSP supporting 20 independent stereo voices. A built-in 4-watt power amplifier drives any speakers or headphones directly; self-powered speakers are not necessary. Orchid's sound board features sampling rates in both playback and record from 4 kHz to 44.1 kHz in mono, and up to 22.05 kHz in stereo.

While more expensive sound boards offer 16-bit sound and a sampling range of up to

44.1 kHz stereo, this is not a drawback for Orchid, since the board's primary use is annotating Windows documents, not creating elaborately mixed sound files.

optional SCSI interface, the Future Design PMC-950 (\$49). If you specify which internal CD-ROM drive you will be using, Orchid Technology will supply the appropriate cabling for your



SHOUT IT OUT: Both of Orchid's new boards include Voice Notes.

Physically located on the Sound Producer Pro's external bracket are 1/8-inch miniconnectors for line-in, microphone, and speakers; a combination game-port/MIDI connector; and a hardware volume control. Since this knob is at the back of the computer when the Sound Producer Pro is installed, you'll probably set the sound level once based on the applications you'll be using, and then rely upon software volume control.

Internally, the Sound Producer Pro features a CD Audio In connector for use with internal CD-ROM drives, a feature lacking in ATI Technologies' StereoFX. Orchid's board also contains an AT-bus CD-ROM interface, making it comparable to Creative Labs' Sound Blaster Pro card in features and functionality.

A better idea, since it offers much better performance, is an

internal ROM drive.

Orchid also provides a cable to let you reroute sound from your internal PC speaker to the Sound Producer Pro. This is probably the most straightforward aspect of the board's installation. Choosing the correct jumper settings and interrupts is always one of the challenging aspects of installing a sound board, but we got the Sound Producer Pro into our test system, a Compaq Deskpro 386/25M running with an external NEC Intersect CD-ROM drive, without too much trouble. Software was more problematic. Orchid's software installation could be better.

As far as the actual sound software is concerned, you're probably better off using just the Windows-based utilities. Orchid's software bundle includes several packages provided by Voyetra, including

DOS-based Sound Tracks, CD Player, Sound Master (a mixing and recording utility), Monologue (a text-to-speech synthesizer package), and Sound Producer Pro Mixer, which operates as a TSR. The far superior Windows-based apps include the popular WinDAT, a Windows-based mixer; and Orchid Voice Notes, a utility that uses OLE (Object Linking and Embedding) to attach voice annotations to Windows apps that support OLE.

The DOS-based utilities proved to be troublesome to use, most noticeably the Sound Master package, which locked up the system on more than one occasion. CD Player worked without incident, but Windows 3.1 is a more logical environment for controlling a CD than DOS is.

SPP Mixer, running as a TSR, was the most annoying of the DOS utilities, since its settings would override the Windows mixer. We were unable to record in stereo under Windows until we remembered to set the TSR mixer to stereo as well. Your best bet is probably to avoid the DOS utilities entirely.

WINDOWS SOFTWARE

The Windows software proved much more friendly and fun. WinDAT is a popular choice among sound board manufacturers, and Windows 3.1 is a far more stable environment for sound than its predecessor, Windows 3.0 with Multimedia Extensions. Once the settings were all correct, we were able to make recordings combining speech with music from a compact disk, a basic task for those looking to create presentations.

The Windows Mixer had a tendency to reset the line and microphone levels (too soft and too loud, respectively), but otherwise was straightforward to use, and it offers some basic filtering to reduce noise. Orchid's Voice Notes is also easy to use, provided your major applications can handle OLE. You drag the annotation

First Looks

icon into your Windows Startup group and the program lies in wait, ready to record whatever comes to mind. Orchid's Windows drivers made using Windows' Media Player and Recorder trouble-free.

For game players, the Sound Producer Pro supports the original AdLib board, Sound Blaster music and speech, Disney's Sound Source, and the Covox Speech Thing. Orchid's small desktop speakers are a perfect match for those looking to enjoy a bit of midday escapism without totally disrupting the work environment.

FARENHEIT VA

If you want to save a slot by having your sound and video on the same board, turn to Orchid's Fahrenheit VA. Even though VESA VL-Bus cards are breaking all previous video speed records, the \$299 board is a

FACT FILE

Sound Producer Pro, Fahrenheit VA
Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300

List price: Sound Producer Pro, \$199; Fahrenheit VA, \$299
In short: Orchid's Sound Producer Pro is a good value for those looking to use voice annotation under Windows. The Fahrenheit VA takes the same sound technology and adds fast Windows video acceleration for \$100 more

 ON READER SERVICE CARD

good example of a very fast, ISA-based video accelerator that should satisfy users without local-bus capabilities.

As with the Sound Producer Pro board, the Fahrenheit VA includes Orchid's Voice Notes, so

you can attach audio messages to any OLE Windows document. An installation disk containing a playback-only version of Voice Notes and a sound driver can be created to enable systems not equipped with the Fahrenheit to play embedded messages.

VIDEO PERFORMANCE

While that voice annotation is certainly a commendable feature, the Fahrenheit is first and foremost a video accelerator. Based on S3's 86C801 graphics processor chip, the Fahrenheit turned in a very impressive 13.4 Graphics Winmark score when it was tested on a 33-MHz Compaq 486M at 800-by-600 resolution with 256 colors. Even faster performance should be expected from Orchid's similarly priced Fahrenheit VA/VLB, a VL-Bus card based on S3's 86C805 chip.

Though not outfitted with pricey VRAM, the Fahrenheit's graphics performance at higher resolutions remained fast with its 1MB of 60-nanosecond DRAM. The included Windows drivers enable it to display 16 million colors at 600-by-480 resolution, 256 colors at 800-by-600 and 1,024-by-768, and 16 colors at 1,280-by-1,024 and 1,280-by-980.

Driver and hardware installation is elementary. Four switches on the back of the card control monitor refresh rates when jumping between resolutions. Orchid also provides a Video Display Setup utility along with its Windows drivers that eases the task of changing display preferences.

Easy installation, reliable video drivers, great performance, and voice annotation make the Fahrenheit VA a steal at \$299. □

■ Organization Charting Windows OrgChart: Better Layout Tools Editing

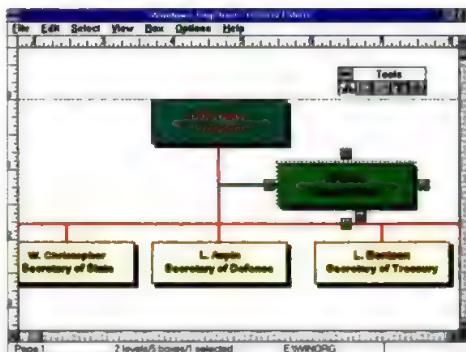
BY DON TRIVETTE

Windows OrgChart, Version 2.0, is an updated and renamed version of ORGcharting, a well-known organization charting program originally developed by Roykore. The \$149 OrgChart 2.0 makes it easy to draw organizational charts for almost any corporation, club, or group you can imagine.

The program starts you off with a blank page and its chief drawing tool, which is a box with tabs or handles representing relationships with the boxes to be added. The top handle represents a manager; the bottom handle, a subordinate; left and right handles are for coworkers, and a fifth handle is for an associate. To add three subordinates, for example, you hold the Shift key and click the bottom handle three times. Instantly three boxes appear under the manager's box, and they're all

connected by neat organizational lines that make sense.

Boxes are automatically arranged in a simple horizontal structure, but you can select eight other formats from the Arrange Work Group menu.



WHO'S ON TOPP: OrgChart 2.0's boxes are its main drawing tools.

Almost everything can be customized using pull-down menus: color and fill; shading; borders; type-style and size; and connecting-line style, color, and

weight. Entering names and titles is also done from a pull-down menu. A preview window lets you check the appearance of these options before applying them to one box, a group of boxes, or all boxes on a chart.

Among OrgChart's enhancements are an improved page layout with three options: fit to page, zoom by percentage, and best fit. The best fit feature is controlled by a set of user-

defined rules for things like text size, box spacing, and page orientation. Other changes in Version 2.0 include support for TrueType fonts and the ability to add multiple top-manager boxes.

Also new is support for OLE (Object Linking and Embedding) as a server. This means changes made in an organizational chart can automatically be made available to other OLE applications. In a bid to woo users from

its chief competitor, OrgChart imports files from Banner Blue's Org Plus for Windows.

MORE NEEDED

A Zoom command would be a nice addition, as would a Copy command and a Redraw command to clean up fragments left on-screen after major changes. The program's freehand drawing capabilities are weak and restricted mostly to straight lines. More serious is the inability to output files in a standard graphics format like .PCX or TIFF; only hard-copy print output is supported.

But despite those glitches, Windows OrgChart 2.0 is a simple tool for drawing and printing org charts in a variety of styles and colors. It sure beats pen and paper.

• **List price:** Windows OrgChart, Version 2.0, \$149; competitive up-grade, \$79. Requires: 2MB RAM, 1MB hard disk space, Microsoft Windows 3.0 or later. Micro-grafx Inc., 1303 Arapaho, Richardson, TX 75081; 800-733-3729, 214-234-1769; fax, 214-234-2410.

Circle 425 on reader service card

Windows Acceleration

Hercules Graphite Card: A \$399 Speed Solution for Windows Video

BY BEN MYERS

The Hercules Graphite Card is a small graphics accelerator card that uses IIT's AGX014 graphics chip, a near clone of IBM's eXtended Graphics Array (XGA) graphics chip, to provide snappy performance under Microsoft Windows for a reasonable retail price of \$399.

The Graphite Card is equipped with 1MB of 80-nano-second video random access memory (VRAM), enough memory to support up to 1,280-by-1,024 resolution with 16 colors, 1024-by-768 with 256 colors, 800-by-600 with 65,536 colors, and 640-by-480 with 16 million colors. The fairly fast VRAM on the card allows noninterlaced

operation with compatible monitors, and also minimizes flicker at higher resolutions and with more colors.

The installation of the Graphite Card is simple and trouble-free. One jumper on the card enables or disables IRQ2, used by some VGA programs that are sensitive to vertical refresh. Another pair makes ad-

justments to deal with different ISA-bus timings.

The DOS software installation program installs the Graphite Card utilities and drivers and allows you to select timing files for optimum operation with a wide range of monitors. Under Windows, there are utilities to select and change resolution and color depth, and to fine-tune the placement and size of the screen image.

After the Graphite Card corrected two defects we found in preliminary testing, its drivers ran the card smoothly at all of the available combinations of resolution and color depth. Beyond Windows, the Graphite Card has a display driver for Autodesk's AutoCAD and related products.

The Graphite Card yields a Graphics Winmark score between 10 and 15 million at 1,024-by-768 noninterlaced resolution with 256 colors, a result that makes it competitive with other cards both in and above its price range (the \$399 Diamond Stealth VRAM and the \$599 ATI Graphics Ultra Pro are examples).

While IBM's XGA can address up to 4MB of memory, the IIT AGX014 graphics chip is capable of addressing up to 6MB of memory, enough for 16 million colors at extremely high resolutions. In the not-too-distant future, you can anticipate other AGX-based graphics cards from Hercules with the memory needed to handle still more colors at high resolution.

The Hercules Graphite Card is one more alternative among the successful second generation of graphics cards designed specifically to speed Windows video performance. For now, it's got a good spot on what's turning out to be a rapidly improving price/performance curve.

• List price: *Hercules Graphite Card*, \$399. *Hercules Computer Technology Inc.*, 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112.

Circle 420 on reader service card

Databases

DataPerfect Lives! New Version has Better Reporting, Improved Utilities

BY DON WILLMOTT

Remember DataPerfect? It's close to two years since WordPerfect Corp. last upgraded its DOS-based, relational, non-programmable database, and much has changed in the database world. But even in the face of new competition from Windows-based packages, WordPerfect has put out a new version rather than put the program to rest.

The improved \$495 DataPerfect 2.3 for DOS is most notable for providing up to 256 indexes per file and multiple lookups without forcing you to do any programming. The interface isn't pretty, but it's functional, helping you design, index, and link data. Custom menu design capabilities also give database application developers freedom to design complex apps.

New to this version is a utility called DP Diagnostics that does a good job of looking at your database design to find flaws in the structure. An improved version

of DPOrder, a utility for changing the order of reports in a list, is also included.

There are also some interesting network features. Using a system called optimistic locking, DataPerfect can allow multiple access to records, and if two users are working on a record at the same time, each is notified if the other has changed a field. Networked users can also run reports simultaneously.



DATA PANELS: DataPerfect guides you through the design of a record.

The DataPerfect program isn't big on direct importation and exportation of data. ASCII-delimited data moves in and out, but everything else (except for WordPerfect merge files)

needs to be converted.

Note that DataPerfect's menu system (updated in this version) slavishly emulates WordPerfect keystrokes (save is F10, exit is F7, and so on). That's a real advantage for WordPerfect users, but people who don't use WordPerfect and are expecting pull-down menus will be in for a surprise.

But help is nearby. In typical WordPerfect style, not only does DataPerfect come with over 500 pages of documentation, but also with more than 300 pages of lessons and two keyboard templates. It also ships with several predefined databases to help you get going.

A Windows version is coming, though apparently not too soon. Until then, DataPerfect diehards should upgrade, while other database users intrigued by the kind of networking and indexing that DataPerfect can offer should take a look.

• List price: *DataPerfect 2.3 for DOS*, \$495; upgrade, \$89 (free if 2.2 was purchased after September 1, 1992); competitive upgrade, \$129. Requires: 256K RAM, DOS 2.1 or later (DOS 3.0 for network use). *WordPerfect Corp.*, 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-228-7000; fax, 801-228-5077.

Circle 430 on reader service card

Experience the magic of database power made easy!

OBJECT
COMPUTING
NOW!

NEW!



Borland Paradox[®] for Windows

Relational database power made easy

Special
Offer!
\$139.95

You'll be amazed at what you can do



If you're looking for the easiest-to-use, most powerful, and most reliable Windows database, new Paradox® for Windows is it! With Paradox for Windows,

Paradox or dBASE® with ease. From letters to labels to mission-critical applications, Paradox for Windows puts your business data to work like never before.

Graphical interface makes it easy

Paradox for Windows' graphical user interface makes it easy to

layers of menus. You work only with the menu options relevant to the task at hand. And special productivity "Experts" help you get your work done even faster. Whether you're creating a form or report, or querying your database for information stored in different tables and formats, there's a productivity Expert to show you the way.



▲ SpeedBar™ icons provide point-and-click access to the features you use most often.

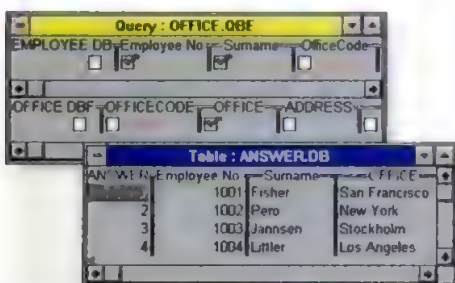
access, modify, and present your data. Object Inspector™ menus make it easy to use all the features and functions of your database, without digging through

Built for Windows, takes full advantage of DOS

Paradox for Windows is built from the ground up to let you take full advantage of the Windows environment. But unlike other Windows databases, Paradox makes it easy to move between DOS and Windows. You get full table and index compatibility with Paradox for DOS and dBASE. Plus, you get a familiar table viewer, consistent QBE, the same validity checks, password encryption, and more.

"The new features make Paradox fly, but it's the revamped interface that makes it soar."

—PC World, August 1992



▲ Get answers quickly by using graphical Query By Example.

there's no limit to what you can do: Create customer lists in seconds, automatically generate reports with the push of a button, or retrieve data from



- Easiest to learn and use
- Relational database power
- Create graphical forms and reports with ease
- Get instant answers to queries
- Effortlessly access your existing Paradox and dBASE data

Paradox for Windows

File Edit Form Record Properties Window Help

WORLD OPTICS

Online Ordering Systems

Customer

Customer No: 201
Telephone: +44.71.423456

Company Name: The Camera Shop
Address: 22 High Street
City: Mayfair, London
Zip/Postal Code: SW1 1RG Country: UK

New
Find
Delete

Order

Print

Order No	Date	Total Amount
2209	1-Jan-92	1,109.00
2286	2-Feb-92	1,235.23
2350	3-Mar-92	1,913.55

Status:
• In Stock
• Back Ordered
• Discontinued

Ship via: One Day
Ordered by: Telephone
P.O. Number: GRT300

Camera

Qty	Unit Price	Total Price
2	1,195.00	2,390.00



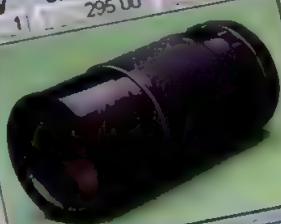
Filters

Qty	Unit Price	Total Price
2	19.00	38.00



Lens

Qty	Unit Price	Total Price
1	295.00	295.00



Borland®
Paradox®
for Windows

1-800-336-6464, ext. 5222

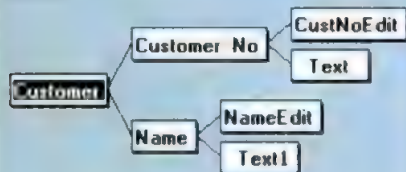
Relational database power made easy

DEVELOPERS CORNER

Unlimited applications development

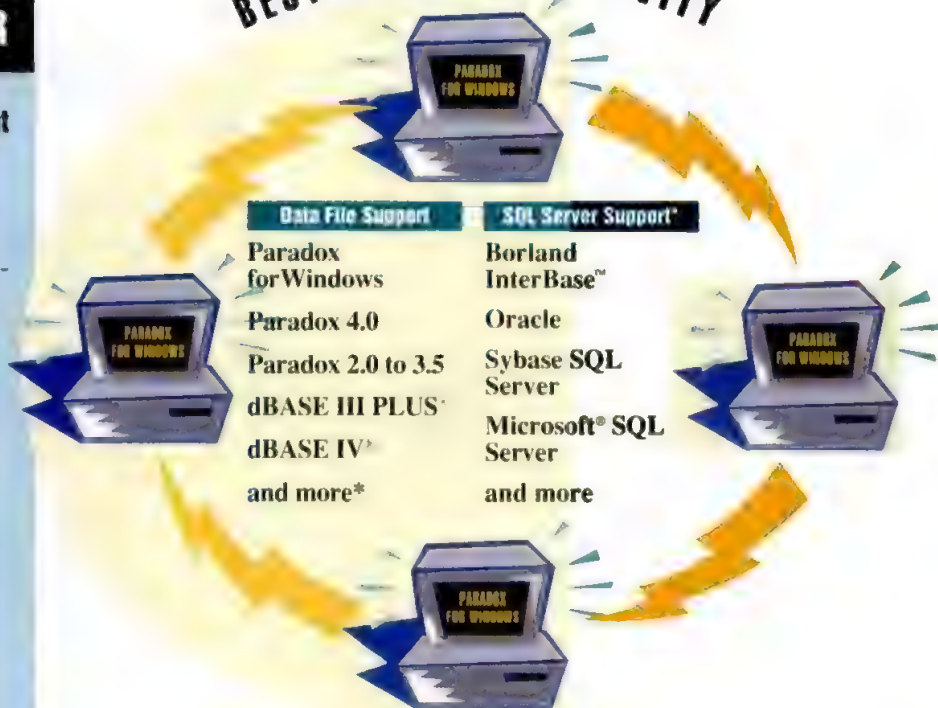
Paradox for Windows enables programmers to create graphically rich custom applications never before possible. ObjectPAL™—a fully structured, high-level language—gives you the benefits of object-oriented programming with easy-to-use, event-driven methods, procedures, and objects. You learn ObjectPAL at your own pace, starting with the basic tools. Then, use the Productivity Switch to turn on more sophisticated features.

Paradox for Windows is perfect for creating fully integrated custom applications for both single- and multiuser systems. A graphical development environment lets you work in Windows to develop and debug your graphical applications. Powerful features like an Object Tree, debugger, built-in editor, and extensive on-line help let you create fantastic Windows applications in record time.



▲ Paradox for Windows' Object Tree helps you build graphical applications fast.

BEST DATA CONNECTIVITY

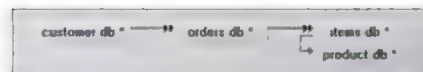


▲ Paradox for Windows lets you easily put all your data to work, without limitations.

The best way to manage your Paradox and dBASE data

No other Windows database gives you complete access to your existing Paradox and dBASE data. You can build multi-table forms, reports, or queries with any combination of Paradox or dBASE tables—and maintain referential integrity and data security automatically! Just select the tables you want, and Paradox for Windows handles

all the work of managing data types and formats for you.



▲ Paradox for Windows allows you to graphically perform relational links to visually see how the tables are related.

New graphical data types

Whether you work on a stand-alone computer or a multiuser network, Paradox for Windows provides seamless, secure con-

Paradox is the best Windows database

USABILITY

	Paradox	Access
Insert 1,000 records*	29 sec	147 sec
Range select: 15,000 of 130,000 records*	<1 sec	16 sec
Graphical form and report design tools	●	●
Graphical Query By Example	●	●
Object inspection menus with right mouse button	●	●
Visual data modeling for forms, reports, and queries	●	●
Full edit capabilities in multi-table forms	●	●
Built-in data types: graphic, formatted memo, binary large objects	●	●

DATA CONNECTIVITY

Full native support for Paradox and dBASE tables	●
Direct creation of Paradox and dBASE tables	●

DATA CONNECTIVITY, continued

	Paradox	Access
Unlimited secondary indexing	●	●
Creation of dBASE field and expression indexes	●	●
Cascading updates in referential integrity	●	●
SAG CLI-compliant middleware connectivity built-in	●	●
Table encryption and security	●	●
Paradox 4.0 and dBASE IV multiuser concurrency	●	●

APPLICATION DEVELOPMENT

Event-driven programming	●	●
Object-oriented development environment	●	●
Programming Productivity Switch	●	●
Graphical object management tools	●	●
Database-specific programming language	●	●

nections to an unprecedented array of data types. You can work with text, numbers, and unlimited length memo fields, complete with graphical attributes like font, size, color, and style. Or work with graphic fields that contain bitmapped pictures, OLE fields that store objects from other Windows applications like spreadsheets and word processors, and even

Binary Large Object (BLOB™) fields, which can include multimedia objects, digitized sound, CAD drawings, and more.

Trust your data to the Data Company

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■ Operating Systems

UnixWare: The Best 32-Bit Operating System...For Now

BY STEVEN J.

VAUGHAN-NICHOLS

Look out, Microsoft. Univel's new UnixWare operating system fires a shot across the bow of Windows/NT and other forthcoming 32-bit operating systems. For \$495 for the Personal Edition or \$2,495 for The Application Server, UnixWare unleashes the combined power of Unix, Novell's NetWare, and DR DOS. Born out of a partnership between Novell and Unix Systems Laboratories (USL), Univel is setting out to offer a solution that can bring the client-server strengths of Unix to NetWare installations.

UnixWare is far more than just another attempt to bring Unix to today's desktops. Despite Unix's unrivaled multitasking and multiuser strengths and its powerful client-server DBMS applications, Unix has always been an also-ran in the desktop operating system mar-

ket. Ever since its inception in 1971, Unix has been burdened with an unfriendly interface and a lack of end-user applications. Unlike other attempts to bridge the Unix/PC gap, such as SCO's Open Desktop, UnixWare neatly deals with both of these problems.

For an interface, UnixWare comes with the newest version of the X Windows network windowing system, X11R5, and both Motif- and Open Look-based GUI front ends. Windows users will find that the Motif-style look and feel closely resembles that of Windows 3.1.

No matter which interface you use, though, Unix's cryptic commands are kept well hidden. To get to them, you must use terminal mode. Most users will never see the Unix command line, much less need to know how to make Unix commands work.

You get the Unix advantages of running multiple programs and multiple sessions without Unix's command-line headaches. While not the equal of the Macintosh interface, you'll find UnixWare's graphical interface to be as user-friendly as Windows'.

WHAT ABOUT APPLICATIONS?

As for applications, UnixWare, built on the new Unix System V, Release 4.2, can run any Open Desktop, Sunsoft's Interactive Unix, SCO Unix System V, and Xenix application without modifications. If a product is Unix-compatible and runs on an Intel processor, it will run on UnixWare. In our tests, we tried the System V versions of Lotus 1-2-3 and WordPerfect; the SCO Xenix version of Grammatik; the SCO Unix version of the Informix database

and Applix's Asterix groupware program. All ran flawlessly.

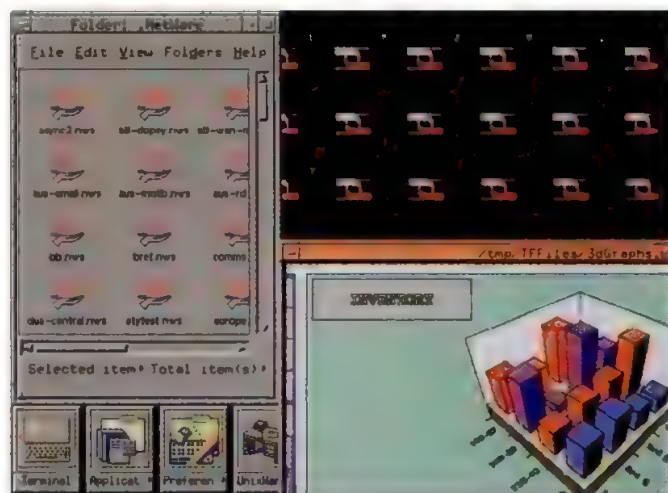
That's pretty exciting for Unix users, but what about DOS and Microsoft Windows applications? No need to worry. UnixWare, equipped with a subset of DR DOS 6.0, will run those, too. Using Windows 3.1 on UnixWare requires a separate module, Windows Merge for UnixWare, but all other DOS

world with TCP/IP and Network File System (NFS).

What's really appealing on the networking front is that you can transparently connect and access data and programs on NetWare servers. UnixWare comes with a full array of NetWare client services.

To access a NetWare server, the server must be running the UnixWare NLM (NetWare Loadable Module). This NLM provides full user and group interoperability across both server types without compromising NetWare security.

For users, this means full access to NetWare services. Files, directories, and peripherals are treated by the



NEW DAY FOR UNIX: UnixWare features a friendly, Windows-like graphical user interface. Navigation is easy.

or Windows 3.0 programs can work with UnixWare. While extended memory can't be emulated, restricting Windows 3.0 to Real mode, up to 8MB of LIM 4.0 expanded memory can be provided for applications. In our tests, WordStar, Version 7.0, and dBASE IV, Version 1.5, performed without a hitch.

Better still, you won't be limited to applications installed on your UnixWare system. UnixWare comes with support for both Transport Control Protocol/Internet Protocol (TCP/IP) and Novell's IPX/SPX networking protocols. On the Unix side, you can hook into the workstation/minicomputer

UnixWare system just as they would be from a NetWare-based client PC.

You can also access Novell's MHS gateway services seamlessly with either version of UnixWare. This enables UnixWare users to send e-mail to NetWare users and vice versa.

The UnixWare/NetWare connection is not a one-way street. The Application Server version of UnixWare allows users to access its system resources by using the 38K Novell Virtual Terminal TSR and an INT14- or INT6b-compatible terminal-emulation or program. You should keep in mind, though, that the UnixWare Application

FACT FILE

UnixWare, Version 1.0

Univel, 2180 Fortune Dr., San Jose, CA 95131; 800-486-4835, 408-729-2300; fax, 408-729-2310

List price: UnixWare Personal Edition, \$495, UnixWare Application Server, \$2,495

Requires: Personal Edition: 8MB RAM, 80MB hard disk space, CD-ROM drive or tape drive; Application Server: 12MB RAM, 120MB hard disk space, CD-ROM drive or tape drive.

In short: UnixWare combines Unix, NetWare, and DOS compatibility with an attractive GUI to make the most powerful 32-bit operating system available today.

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First Looks

Server is not a NetWare server. What you gain from using UnixWare as a server is easy access to Unix-based applications such as databases.

INSTALLATION AND SPEED

Unix and NetWare both have bad reputations as being real monsters when it comes to installation. Believe it or not, UnixWare is a dream to install. Installation consists merely of inserting three floppy disks and a CD-ROM and tapping a key every now and then. There are, however, several gotchas that you need to steer clear of.

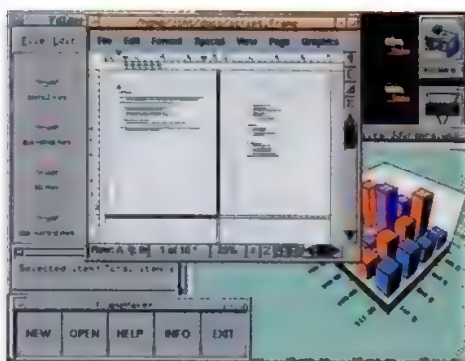
First, like all of the Unix family members, UnixWare will not work with all PC-based peripherals. For example, you can install UnixWare across a network, from a CD-ROM, or from QIC-24 tape. In all three of those cases, however, you must have the right equipment or UnixWare won't get off the ground. All CD-ROMs and most QIC tape drives, for instance, must be attached to the bus with a SCSI adapter. Univel supplies a listing of tested equipment, and you would be wise to stick to it.

Second, Univel is not kidding about requiring a minimum of a 33-MHz 386DX-based computer and 12MB of RAM for the Application Server. UnixWare can do a lot for you, but it demands lots of system resources to do so.

Even with ample RAM and CPU speed, UnixWare is much slower than Windows 3.1 on the same platform. Of course, this is partly due to the fact that UnixWare does more than Windows 3.1. UnixWare, built from the ground up to be multitasking, multiuser-capable, and networkable, puts more of a burden on a system.

GETTING UP TO SPEED

One worry you won't have is learning how to use the environment. For a brand-new applica-



HEAVY DUTY: FrameMaker flourishes in UnixWare.

we have seen for any Unix environment.

The operating system also comes with an excellent on-line help system with a twist. You can add your own notes to the help files so you can, for example, put comments that are specific to your network setup in the networking section. LAN administrators will love this feature.

UnixWare stands alone as the preeminent 32-bit operating system today. Even after Windows/NT finally appears, UnixWare still may be a high-end operating system of choice for power users.

With its ease of use, built-in interoperability, multitasking, and ability to run almost every application that works in the Intel world, there's a lot to like about UnixWare and little to dislike. Once Windows 3.1 support is supplied, albeit only in Standard mode, UnixWare will be the 32-bit operating system to beat. □

tion, UnixWare's manuals are unusually well written and complete; in fact, they are the best

AND THE WINNER IS...

With Windows/NT still somewhere just over the horizon,

■ Contact Management Dynodex: Mac Veteran Becomes Capable Windows Contact Manager

BY JONATHAN MATZKIN

Portfolio Software's \$89.95 Dynodex for Windows may be the last word in telephone- and contact-management. Long popular with Mac users, Dynodex is an excellent compromise between flexibility and structure.

The program presents an initial view of three separate windows. One displays a data entry template, while another shows a tabular view of the current database. The third holds a toolbar that gives quick access to commonly used features. This on-screen layout is virtually self-explanatory, but most questions that do arise can be quickly answered by consulting the lucidly written manual.

All of Dynodex's fields, including a note field that accepts up to 5K of text, can be searched on a full-text basis. That means you can look for any string entered in any record, regardless of where you may have put it. Many similar products lack this simple feature,

and it sets Dynodex apart from the competition. You can sort records on any field in the basic template, or use up to three fields to define a hierarchical sort.

You can't create your own field structure, but Dynodex's design amply provides for virtually any need that might arise when tracking telephone numbers, addresses, and contacts (field labels are editable). In addition to the expected name and address fields, the template provides four separate telephone number fields, and three fields marked "key1" through "key3". These aren't keyword fields in the usual database sense, and

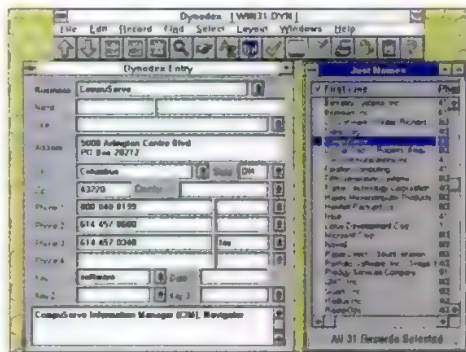
can be used for any purpose you desire since they will accept any alphanumeric data.

Dynodex has several features that speed searches and data entry. "Shorthand" keys can be defined easily for each field, so that typing one letter triggers insertion of an entire label. Phone number fields, for instance, can be set up so that typing the letter "O" inserts the word "office," while typing the letter "H" inputs the word "home."

There's not much to complain about with Dynodex. The package supports DDE (Dynamic Data Exchange) but imports and exports only comma- and tab-delimited ASCII files. Support for at least .DBF and .WK1 files should be included. And power users may turn up their noses when they find out that they can't create their own data entry templates. Most users, however, will find Dynodex to be an intelligently designed solution for managing phone numbers and contacts.

• **List Price:** Dynodex, Version 1.0, \$89.95. **Requires:** 2MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. **Portfolio Software Inc., 10062 Miller Ave., #201, Cupertino, CA 95014; 800-729-3966; 408-252-0420; fax, 408-252-0440.**

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WHO YOU GONNA CALL? Dynodex's main windows manipulate your phone database.

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—PC Magazine, December 22, 1992

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Network Printers Steal HP Thunder

Compaq's new low-cost, high-speed PageMarq laser printers should give the Hewlett-Packard LaserJet IIIsi a run for its money. The PageMarqs fix the major deficiencies of many earlier network

—PC Week, September 7, 1992

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—Macworld, January 1993

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According to PC Week, the COMPAQ
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-PC Week, September 7, 1992

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BIS Special Report, August 1992

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According to analysts at BIS
Strategic Decisions in Norwell,
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scored a bull's-eye. "Its kind of fea-
tures are state-of-the-art. They've

-Computerworld, September 21, 1992

and support program in
the industry.



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CIRCLE 137 ON READER SERVICE CARD

Printer Enhancements

doubleRES 4 Sharpens HP LaserJet Resolution without Special Cables

BY EDWARD MENDELSON

LPAC's \$599 doubleRES 4 doubles the resolution of an HP LaserJet II or III from 300 to 600 dots per inch without requiring an expansion board in your computer or a replacement motherboard in your printer.

Unlike other products that give you sharper and clearer output from a 300-dpi printer, doubleRES works with the parallel printer cable you already use. All you do is insert a small expansion board in the optional I/O slot on the back of your printer and move the printer cable from the printer's parallel port to the port on the new board. You use the printer's front-panel menu to tell the printer to use the I/O slot for input, and you're ready to print.

The only software in the package is a Microsoft Windows driver that lets you use TrueType and ATM fonts exactly the same way you use them with other printers. Under Windows you can choose between 600- and 300-dpi resolution. DOS applications, however, still print at 300-dpi resolution. You can use the Windows LaserJet driver if you want to use LaserJet font cartridges or soft fonts. Any PostScript cartridges print only at 300 dpi.

The doubleRES system produces clear, sharp output at high speeds. On a 66-MHz system, a complex page with multiple fonts and graphics that took 39 seconds to print to the normal HP LaserJet III at 300 dpi took only 26 seconds to print at 600 dpi with doubleRES. Slower computers will show less of a speed increase.

Ordinary text files don't benefit much from the increased speed. A ten-page Word for Windows file, with a few TrueType fonts, needed 91 sec-

onds on the normal LaserJet III, 90 seconds with doubleRES at 600 dpi, and 88 seconds with doubleRES at 300 dpi.

Compared to the more complex and powerful \$495 WinJet/800 from LaserMaster, which uses an add-in board in the computer, doubleRES produces marginally inferior graphics,

doesn't offer PostScript compatibility, and doesn't come with fonts. While WinJet prints at speeds generally better than doubleRES at low resolution, doubleRES is faster at high resolution and needs only 4MB of RAM. WinJet needs 8MB for high resolution.

Take the manual seriously

when it tells you to switch off Windows' Print Manager. When we tried to print with Print Manager on, the computer locked up and we had to reinstall the driver. Otherwise, the system produced fast, sharp output at an impressively low price, with easier installation than any competing product.

• List price: *double*RES 4, \$599. Requires: HP LaserJet II or III. LPAC, 10865 Rancho Bernardo Rd., San Diego, CA 92127; 800-225-4098, 619-485-8411; fax, 619-487-5809.

Circle 431 on reader service card

LAN Utilities

AlertVIEW Sends Alarms And Repairs Across the LAN

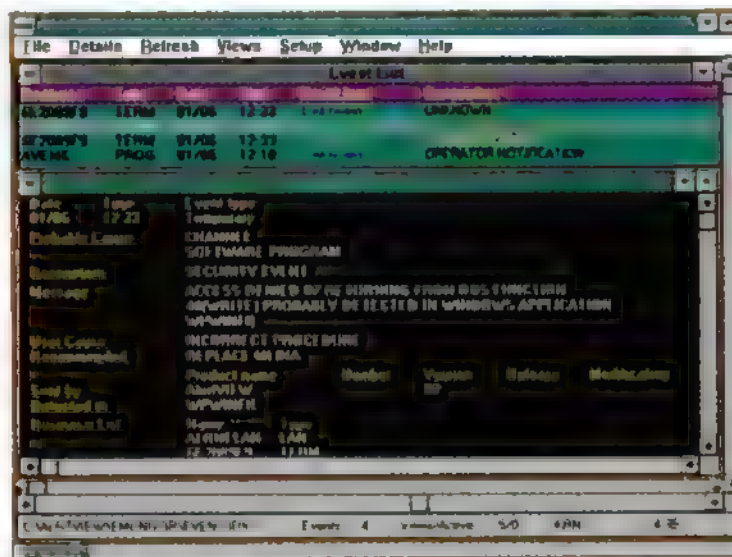
BY STEVE RIGNEY

As long as a LAN is connected to all the PCs in an organization, why not use it to solve computer-related problems? That's the philosophy of Shany's \$995 AlertVIEW 2.0, a LAN utility that delivers information on the status of connected PCs and their problems. It is a useful tool for network administrators as well as people working at help desks and computer resource centers. AlertVIEW gives the status of the computer both before and after a problem occurs, and in some instances it automatically fixes the problem.

The package comes in both DOS/Windows and OS/2 configurations (both come in 10-user packs), and though it was originally designed as a software monitoring and management package for an IBM LAN Server running over Token-Ring, AlertVIEW 2.0 also supports Novell's NetWare. Unfortunately, the manual includes only an inadequate addendum discussing operation with NetWare.

AlertVIEW includes three

programs that work together. The core of the package is the AlertVIEW Station (AVS), a program that runs as a TSR on each PC you want to manage. You can load the TSR into expanded memory leaving only an 8K stub of the program in conventional memory. If you don't load the program high, the TSR



FROM A DISTANCE: *The AlertVIEW Event Monitor tells you the cause of a remote software problem and suggests fixes.*

requires 22K of conventional memory. AVS monitors the system and gathers information to send to the network manager.

The AlertVIEW Manager (AVM) runs on any management or help-desk PC. You can start AVM from a Windows icon or from the DOS command line and use the AVM console to control the AlertVIEW-

equipped systems remotely. You can reboot a remote workstation, freeze a remote application, send messages to particular PCs, or monitor how an application is being used.

The third program, Alert-VIEW Event Monitor, collects, displays, and reacts to alerts from the PCs running AVS. You can program the Event Monitor to fix problems, such as improper print job redirection or having too many files open. It can automatically modify the CONFIG.SYS of a client PC to increase the FILES= statement in response to certain error reports.

AlertVIEW is a powerful assistant for any LAN administrator. It needs better documentation, but after you get going, you'll find your LAN-management capabilities much extended.

• **List price:** *AlertVIEW, Version 2.0: DOS/Windows version, \$995 (10 users); OS/2 version, \$1,295 (10 users).*

Requires: 6MB RAM, 8MB hard disk space, Microsoft Windows 3.0 or later, OS/2 1.3 or 2.0, Novell's NetWare 2.0 or 3.11, IBM LAN Server, Microsoft LAN Manager, or any NetBIOS-compatible network. Shany Inc., 2680 BayShore Pkwy., #104, Mountain View, CA 94043; 415-694-7410; fax, 415-694-4728.

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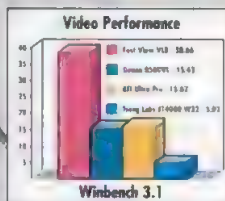
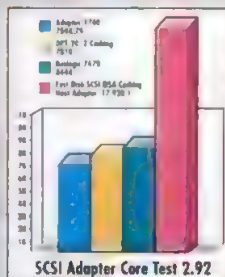
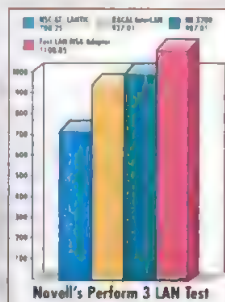
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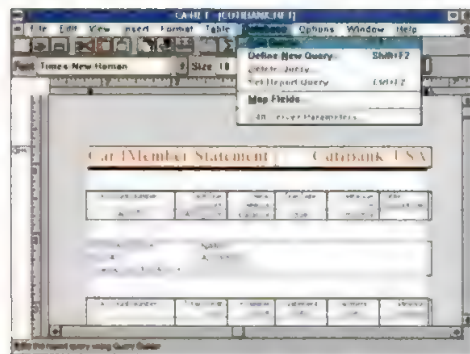
By Brad Grimes

NEW

Computer Associates Ships WYSIWYG Report Writer

Computer Associates has a new Windows-based report writer for CA-Clipper and dBASE databases called CA-RET/Xbase (CA-RET is pronounced "carrot"). CA-RET/Xbase is a WYSIWYG report designer that also works with ASCII files and takes advantage of several advanced Windows features. You can drag and drop fields anywhere in your report and set up DDE (Dynamic Data Exchange) links with CA-RET/Xbase acting as a server application. The program has the look and feel of a Windows word processor with formatting, word wrap, and previewing capabilities, as well as widow/orphan and page break control. There is a toolbar for adding text, data fields, graphics, images, and headers and footers.

CA-RET/Xbase provides a number of ways to modify the query used to access data. Besides an editable structured query language, CA-RET/Xbase gives you the ability to point and click on tables and link them to fields in your report and then further customize the data criteria by clicking on icons. CA-RET/Xbase comes with commonly-used report formats as



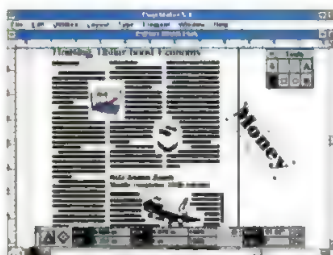
In CA-RET/Xbase you can easily edit queries

well as over 40 built-in functions ranging from financial to mathematical. Functions can operate on database fields and can be nested to create more complex expressions.

• List price: CA-RET/Xbase, Version 1.0, \$295. Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788-7000; 800-225-5224, 516-342-5221; fax, 516-342-5329.

Circle 407 on reader service card

HOT PROSPECT



PageMaker 5.0: Ready to Meet The QuarkXPress Challenge

Now that QuarkXPress for Windows has altered the desktop publishing landscape, Aldus is responding with Version 5.0 of PageMaker for Windows. In an effort to reestablish itself with graphic artists and to maintain its popularity with users preparing both short and long documents, Aldus has added over 100 new features, including the Pantone color-matching system and the ability to print color separations.

PageMaker 5.0 makes manipulating and editing text and graphics easier; in increments of 1/100 of a degree either manually or via a numeric control palette. The control palette also gives you the ability to crop, nudge, scale, size, and skew blocks of graphics and text via push buttons. And editing rotated blocks is now done directly in the page layout.

Other enhancements to Version 5.0 help link PageMaker files to one another and to other Windows applications. Now you can open almost any number of PageMaker publications at once and drag and drop blocks across them. PageMaker 5.0 also supports OLE (Object Linking and Embedding) for sharing data with or placing PageMaker publications in other Windows applications.

• List price: Aldus PageMaker, Version 5.0, \$895. Aldus Corp., 411 First Ave. South, Seattle, WA 98104-2871; 206-622-5500.

Circle 401 on reader service card

NEW

ZDS Puts Intel 486SL/25 Chip In Its Z-Note 425Lnc

Zenith Data Systems is one of the first PC vendors to put a power-saving 25-MHz 486SL processor in a notebook computer. The Z-Note 425Lnc Model 200 features the much-anticipated (and recently discontinued) Intel chip, which shares the power-management smarts of the 386SL, and also includes an active-matrix color display and a 200MB hard disk. With the battery installed, the 1.8-by-11.7-by-8.5-inch (HWD) Z-Note 425Lnc weighs 6.5 pounds.

Also in the family are the Z-Note 425Ln, a monochrome version, and the Z-Note 425Lnp, a passive-matrix color version, both with 120MB hard disks. Current Z-Note owners will be able to upgrade to the 486SL by means of a board exchange. All configurations come with DOS 5.0, Windows 3.1, a Logitech TrackMan Portable, and a ReadyDesk Port Replicator.

• List price: Z-Note 425Lnc, \$3,999; Z-Note 425Lnp, \$3,299; Z-Note 425Ln, \$2,599. Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60088; 800-533-0331, 708-808-5000; fax, 800-427-7211.

Circle 402 on reader service card



The 6.5-pound Z-Note 425Lnc Model 200 features active-matrix color and a 25-MHz 486SL processor.

IMPROVED

DoubleDisk GOLD Improves Disk Compression, Access Time

Vertisoft Systems is jumping straight to Version 6.0 of its on-the-fly data-compression utility, DoubleDisk GOLD, with full support for removable media such as floppy, Bernoulli, SyDOS, and Floptical disks. While claiming an additional 20 percent compression and faster disk access time due to a new algorithm,

Photography by Thom O'Connor

New & Improved

DoubleDisk GOLD also has memory support for conventional, extended, expanded, and UMB driver loading.

If you've used DoubleDisk 2.6, the last available version of the program, your files will automatically be converted to the new format. DoubleDisk GOLD supports compressed partitions up to 512MB, and for DOS 3.x users it supports compressed partitions up to 128MB. To review compression performance, DoubleDisk GOLD comes with a reporting utility for giving statistics by file, directory, and drive. There is also a disk repair utility and on-line, context-sensitive help within utilities for use during installation.

- List price: *DoubleDisk GOLD, Version 6.0*, \$99.95; *Vertisoft Systems Inc., Transamerica Pyramid, 4th Floor, 600 Montgomery St., San Francisco, CA 94111*; 415-956-5999; fax, 415-956-5355.

Circle 403 on reader service card

NEW

New From Olivetti: Subnotebook, Portable Printer

ISC-Bunker Ramo, the U.S. distributor for Olivetti, has introduced portable products including the Olivetti Quaderno, a 2.2-lb. subnotebook based on the 16-MHz NEC V30HL, and the Olivetti JP 150, a 6.4-lb. bubble-jet printer capable of printing 300 by 300 dots per inch. The Quaderno measures 1.3 by 8.3 by 5.8 inches (HWD) and comes with a 20MB hard disk. It uses a nickel cadmium battery that is rated by the manufacturer to last 8 hours and can be purchased with an external 3.5-inch floppy disk drive. Built into the system is a microphone and loudspeaker for use with a voice-processing system that records your voice to the hard disk for purposes of dictation or verbal annotation of documents. The Quaderno has a 7-inch LCD with 8 gray shades, a 94-key keyboard including a 16-key numeric keypad and 10 function keys, and both serial and parallel interfaces.

The Olivetti JP 150 emulates a Hewlett-Packard DeskJet Plus using the PCL 3 language, and can emulate an Epson FX or IBM ProPrinter with optional add-in cards. It measures 10.7 by 13.3 by 14 inches (HWD) when open on the desk, including the 70-sheet automatic feeder. There are 4 resident fonts, 15 available font cards, and 3 soft font kits. At 10 cpi, the JP 150 has a rated print speed of 160 cps in draft mode and 80 cps in letter-quality mode.

- List price: *Olivetti Quaderno*, \$1,050; *Olivetti JP 150*, \$375. *ISC-Bunker Ramo, 22425 E. Apple Way, Spokane, WA 99019-9534*; 800-633-9909, 509-927-5600; fax, 509-927-5700.

Circle 404 on reader service card

BRIEFS

MONITORS

Samsung Electronics has added a 20-inch monitor to its SyncMaster line aimed at CAD/CAM, desktop publishing, and engineering apps. The SyncMaster 6c (\$2,699), a flat-screen monitor with a .31-mm dot pitch and maximum noninterlaced resolution of 1,280-by-1,024, has microprocessor-based control of 8 preset and 20 programmable screen settings. 201-229-4000; fax, 201-229-4110.

ViewSonic is shipping the new ViewSonic 15 (\$849) with color temperature control. Its microprocessor-based architecture lets you store 26 programmable settings in memory. The flat-square display is capable of 1,280-by-1,024 noninterlaced resolution and has .28-mm dot pitch. 800-888-8583, 909-869-7976; fax, 909-869-7958

ETC Computer has rolled out a line of color monitors. The CA-1460 (\$499) and CA-1560 (\$599), the low-end of the line, measure 14 and 15 inches, respectively. They have .28-mm dot pitch and a maximum noninterlaced resolution of 1,024-by-768 with vertical refresh rates up to 100 Hz.

The CA-1464 (\$549), CA-1565E (\$649), and CA-1565C (\$699) measure 14, 15, and 15 inches, respectively. They are capable of 1,280-by-1,024 noninterlaced resolutions and vertical refresh rates of up to 120 Hz. The CA-1565C displays the monitor settings in an alphanumeric LCD, while the other two display settings in eight LED bars. 510-226-6250; fax, 510-226-6252.

Envivio is shipping a 10.5-inch flat-panel color display for use with desktop or portable PCs. The active-matrix ColorFrame (\$5,495) measures 9 by 12 by 2.5 inches (HWD) and fits into a briefcase. 612-339-1008; fax, 612-339-1369

Sceptre Technologies is making its mark with five new color monitors with push-button microprocessor-based controls. The CC-6N and CE-6N (\$695 each) are 14-inch monitors. The CC-615 and CL-615+ (\$795 each) are flat-screen 15-inch monitors, and the CL-617 (\$1,395) is a flat-screen 17-inch monitor. The 15-

IMPROVED

Dozens of New Commands Boost DesignCAD 2D's Flexibility

American Small Business Computers has completely rewritten its DOS-based DesignCAD 2D. Version 6.0 of this easy-to-use computer-aided design program features 54 new commands and 79 new options, including more colors, curve types, and dimension options to enhance drawings. With the new DOS Shell command you can exit DesignCAD 2D temporarily to perform DOS functions, and the highly customizable user interface has been improved to handle the wealth of new commands and options.

Progressive measurement commands now let you dimension parts of an area as well as the entire object, and a new preview feature lets you see the dimensions you've chosen before committing them to your drawing. New grouping features treat selected objects in a drawing as a single object that can be edited, moved, or copied.

You can also define multiple groups in the same drawing and switch between them when editing.

- List price: *DesignCAD 2D, Version 6.0*, \$349. *American Small Business Computers Inc., One American Way, Pryor, OK 74361*; 918-825-4844; fax, 918-825-6359.

Circle 405 on reader service card

NEW

Apexx Offers Network Adapter For Windows for Workgroups

Microsoft Windows for Workgroups has an ally in **Apexx Technology's** new WINLAN network adapter. The Network Starter Kit includes two ISA cards and 20 feet of RJ-11 telephone cable, which is all the hardware that you will need in order to connect two PCs in a peer-to-peer configuration. You set up the software in the Windows Setup utility, where you also load the network driver that is provided in the Starter Kit by Apexx.

The WINLAN adapter also supports DOS PCs running the MS-DOS Workgroup Connection software with DOS versions 3.1 and later. Additional nodes are attached by purchasing separate Single User Kits and setting up the hardware and software as before. You can connect up to 30 PCs at distances of up to 500 feet, and data is transferred over the WINLAN network at 460,800 bps. Every kit also comes with WINLAN's own diagnostic software utility to analyze network connections and report errors.

• List price: *WINLAN Network Starter Kit*, \$199; *WINLAN Single User Kit*, \$109. *Apexx Technology Inc.*, P.O. Box 9291, Boise, ID 83707; 208-336-9400; fax, 208-336-9445.
Circle 406 on reader service card

NEW

The Complete Modem Plus Goes External

The Complete Modem Plus from **The Complete PC** now has an external sibling. The Complete Modem Plus External, a low-cost, Hayes-compatible external data modem with send and receive fax capability, attaches directly to the serial port. It operates as a 2,400-bps data



The Complete Modem Plus External sends faxes at 9,600 bps with the included RapidFAX for Windows.

modem and as a Group III-compatible 4,800-bps receive-fax and 9,600-bps send-fax modem.

The Complete Modem Plus External comes with Bit-Com communications software with V.42bis and MNP 5 error correction/compression

and Rapid-FAX for DOS for faxing from DOS applications. For Windows users, the product also ships with The Complete PC's new RapidFAX for Windows, which supports EIA Class 1 and Class 2 fax modems and includes such fax software amenities as an 8,000-name phone book and the ability to schedule fax transmission.

• List price: *The Complete Modem Plus External*, \$149. *The Complete PC*, 1983 Concourse Dr., San Jose, CA 95131; 800-229-1753, 408-434-0145; fax, 408-434-1048.

Circle 410 on reader service card

NEW

NEC Ready 466 Adds CO/Session For Remote Diagnostics

NEC Technologies has added a 486DX2/66 system to its Ready line of low-cost PCs. The Ready 466 comes with 8MB of RAM (expandable to 64MB); a 240MB hard disk; 24-bit true-color video at 640-by-480 resolution; and a 14-inch, 1,024-by-768 noninterlaced Ready monitor.

The Ready line is designed to be a plug-and-play solution, so NEC includes a wide array of application software. Ready systems include

BRIEFS

MONITORS

and 17-inch monitors feature automatic and manual degaussing to eliminate magnetic interference. 714-993-9193, fax, 714-993-2997.

SCANNERS

Epson America is selling two new 24-bit color flatbed scanners. The ES-600C (\$1,424) and the ES-800C (\$1,898) support SCSI and parallel interfaces and incorporate the TWAIN standard. Epson's TruePass technology allows you to correct colors while scanning, and for flexible scanning both of the products give you three-pass capabilities. 800-289-3776.

Talent Tech is shipping the 600-dot-per-inch ArtiScan Color Image Scanner Model 6000C (\$1,100). The ArtiScan is a flatbed desktop scanner that you can use in either color or black-and-white modes. You can also scan transparencies and slides. 818-448-8168; fax, 818-990-1264

Nikon Electronic Imaging has a different kind of scanner in its CoolScan 35-mm film scanner. The CoolScan operates as either an internal (\$2,195) or external (\$2,415) unit and captures 24 bits per pixel in a single-pass RGB scan of both color and black-and-white 35-mm negatives. The CoolScan unit yields a maximum resolution of 2,700 dots per inch. 516-547-4355; fax, 516-547-0305.

CD-ROMs

Compton's NewMedia is shipping two new CD-ROMs. The first, Compton's Multimedia Golf Guide: California/Hawaii Edition (\$59.95), is a reference guide with over 750 courses plus tips from pros, tournament histories, and a glossary of golf terms. Also included is Access Software's Links golf simulation game.

The second offering is *USA Today: The '90s Volume One* (\$69.95), a collection of more than 100,000 news stories from January 1990, to August 1992, that includes text, graphics, photos, and audio. The search and retrieval engine employed by the product is Compton's NewMedia's own SmartRetrieve. 619-929-2500.

NEC Desktop, a version of Symantec's Norton Desktop for Windows, The Norton AntiVirus, PFS:WindowWorks (with 25 customized business templates), the Prodigy on-line service, and Quicken for Windows (with two months of free electronic checking). An added bonus is CO/Session Remote Communication Software and a data/fax modem for use with NEC's ReadyRemote support service. You call NEC and a customer support representative dials into your Ready system, takes control, and diagnoses the system's problems.

• List price: *NEC Ready 466*, \$2,799. *NEC Technologies Inc.*, 1414 Massachusetts Ave., Boxborough, MA 01719-2298; 508-264-8000.

Circle 408 on reader service card

IMPROVED

MathType Version 3.0 Supports OLE and TrueType Fonts

The MathType equation editor from **Design Science** has undergone a major upgrade for Version 3.0, adding features that eclipse both Version 1.1 and the stripped-down version that ships with Microsoft Word for Windows. MathType now supports OLE (Object Linking and Embedding) and includes new TrueType fonts. With OLE you can start MathType from within Windows applications or click on a linked equation to edit it.

When editing equations in MathType 3.0, you can use new macros for tasks such as numbering equations and changing styles and sizes. You can also save preference settings, such as style sheets, for jobs like creating math tests or overhead slides. There is also a translator for converting equations to the WordPerfect equation language.

• List price: *MathType, Version 3.0*, \$199. *Design Science Inc.*, 4028 Broadway, Long Beach, CA 90803; 310-433-0685; fax, 310-433-6969.

Circle 409 on reader service card

NEW

TouchStone Takes Building Block Approach to Diagnostics

TouchStone Software Corp. has rolled out its next generation of diagnostic software to succeed CheckIt 3.0. The new CheckIt PRO series of diagnostic utilities is made up of three volumes: CheckIt PRO: SysInfo, CheckIt PRO: Tests and Tools, and CheckIt PRO: Analysis.

CheckIt PRO: SysInfo is the first volume and the base program on which the series is built. It performs basic system diagnosis and can depict the information in over 50 charts and

Introducing CONNEXPERTS® NET Solution™

A powerful, comprehensive network solution that's easy to install and use.

Our NET Solution is a family of networking products that includes all the elements needed for most networking applications. Based on a breakthrough networking technology called ACTLAN™, the NET Solution makes networking accessible to the average businessperson without compromising performance or compatibility with industry standards. **If you think the Macintosh® or Windows® made computing easier, wait until you see how easy this makes networking!**

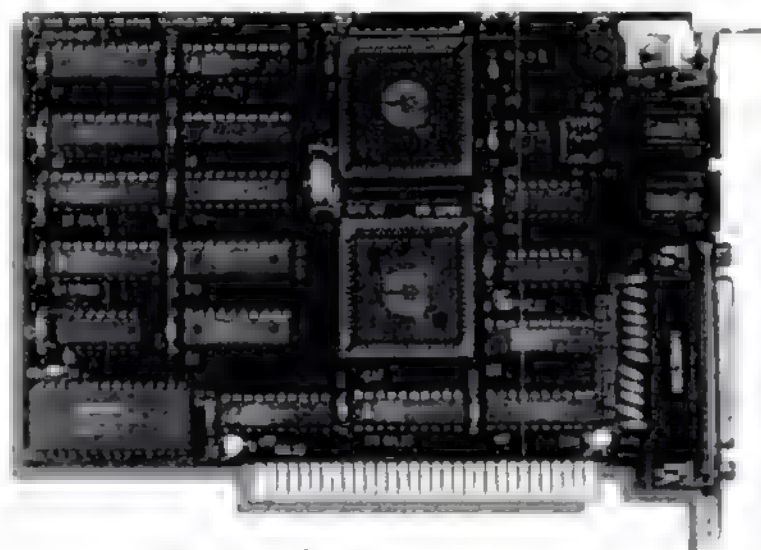
Consider first our NS-8 Network Connection Card pictured here. Installing this card does NOT involve selecting interrupts, I/O ports, shared memory locations or any of the other technical details one must tackle with all other network cards. Yet, despite the no-brainer installation, this card is more powerful and capable than any other network card available. Hyperbole? Hardly. Just look at the NS-8's specs and flexibility. For example: **these cards can form a peer-to-peer network providing printer sharing, E-Mail and PC-to-PC file transfer services WITHOUT requiring a network operating system.** Just connect them and you've got a network.

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*12 Megabits-per-second
bandwidth (FYI, Ethernet is 10Mbps)*

*Up to
255
users*

*No hub
needed
(even the
T-connector is
built in)*



*Network Co-processor
relieves host PC of
most network "work".*

*77,000 cps print
server built-in*

*Uses UTP
cable*

*(i.e., telephone wire with
RJ-11 connectors)*

*Works with
or without
network
software*

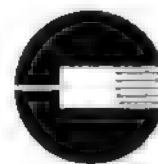
optional driver software makes it possible. The beauty of our NET Solution is: **you can begin networking using the cards alone, with the option of moving up to peer-to-peer or client/server networking just by adding the network software of your choice.**

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New & Improved

graphs that describe the hardware, software, and system setup. Volume 2, **CheckIt PRO: Tests and Tools**, provides advanced diagnosis of hardware problems to identify faulty components such as bad RAM chips and also has a virus checking program. The third volume, **CheckIt PRO: Analysis**, is able to rate your system's performance to identify potential problems, as well as detect configuration changes and report hardware and software problems caused by conflicting components.

- List price: *CheckIt PRO: SysInfo*, \$99.95; bundled with *CheckIt PRO: Tests and Tools* and *CheckIt PRO: Analysis*, \$179.95. **TouchStone Software Corp.**, 2130 Main St., #250, Huntington Beach, CA 92648; 800-531-0450, 714-969-7746; fax, 714-960-1886.

Circle 411 on reader service card

NEW

Fax Vault Provides Low-Cost Fax-on-Demand

Companies that receive numerous requests for product literature, forms, technical information, or other documents will be interested in **Bogen Communications'** new Fax Vault fax-on-demand system. The Fax Vault stores up to 999 pages of information for retrieval in a self-contained 4- by 15- by 10-inch unit. Callers use a touch-tone phone to navigate a menu of voice prompts and select information to be sent to any Group III-compatible fax machine.

As owner of the Fax Vault, you have the option to change the voice prompts and security codes from a touch-tone phone. Fax Vault features a three-level security system that controls access to the system and to specific documents. You can also choose a variety of foreign language voice prompts, automatically generate cover pages, and restrict the number of pages transmitted per call.

- List price: *Fax Vault: two lines*, \$2,995; *four lines*, \$3,995. **Bogen Communications Inc.**, Office Automation Systems Division, 50 Spring St., Ramsey, NJ 07446; 201-934-8500; fax, 800-438-2329.

Circle 412 on reader service card

NEW

Scan, Store, and Retrieve Data with Recollect

Recollect for Windows from **Rebus Technology** is a document image-management tool for storing and retrieving word processor documents, electronic fax files, and TIFF images. It also supports a variety of scanners so you can scan

BRIEFS

MONITORS

Horizons Technology has introduced **Sure!Maps** (\$349), an interactive database on CD-ROM that includes ten detailed maps of major metropolitan areas, an outline map of the U.S., a world map, a database of 32,000 cites, and a sample satellite image of the Dallas/Fort Worth area. **Sure!Maps** has data sets for city names, area codes, and ZIP codes so you can view an area simply by entering relevant information. 800-828-3808.

The CD-Sourcebook of American History-Volume 1 (\$149) from **Infobases International** contains almost 1,000 primary source documents and 28 volumes of interpretive history plus graphics and photos covering events from pre-Columbian voyages all the way up to World War I. Every word is indexed for easy search and retrieval of documents. Documents can be compared in multiple windows, printed, or copied to a word processor. 800-274-1048, 801-224-2223.

Ellis Enterprises is currently shipping **The New Bible Library** (\$495), a collection of 14 Bibles, 5 word studies, 3 Bible commentaries, and 17 dictionaries and references contained on a single CD-ROM. During searches you can take notes on a notepad and then import them to a word processor. There's also a highlighting feature included for marking text. The search-and-retrieval software is manufactured by IBM. 800-729-9500.

Microsoft Corp. has put its Office for Windows suite of business applications on CD-ROM. The \$750 product includes Microsoft Word for Windows 2.0, Microsoft Excel 4.0, Microsoft PowerPoint 3.0, and a workstation license for Microsoft Mail 3.0. 800-426-9400, 206-882-8080.

CBIS is currently shipping a version of its CD Connection networking software that uses Banyan's VINES (\$695 for ten users). Up to 99 users on a VINES network can have simultaneous access to up to 28 CD-ROM drives in a single CD server system. 404-446-1332.

and store faxes, forms, magazine articles, and photographs. **Recollect's** Auto-indexing feature takes scanned documents containing text, converts them to ASCII using Caere's optical character recognition (OCR) engine, and indexes them in a free-form database.

Recollect compresses documents and images to save hard disk space. After performing a full-text, fuzzy, or Boolean search, documents and images are displayed in their own window and in a series of thumbnail sketches.

- List price: *Recollect for Windows, Version 1.0*, \$795. **Rebus Technology Inc.**, 243 Forest Ct., Auburn, CA 95603; 916-888-6452; fax, 916-885-0388.

Circle 413 on reader service card

NEW

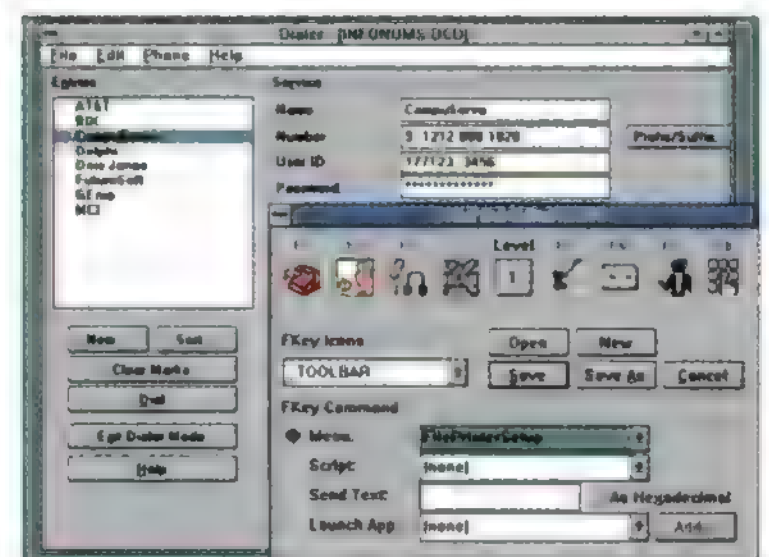
FutureSoft Ships Comm-Fax Software Combination

Terminal Plus with **FAXit** is a new Windows-based communications and fax software package from **FutureSoft Engineering**. As a communications program, **Terminal Plus** has an automatic phone dialer with queuing capabilities, preconfigured modem settings for over 80 modems, and log-in scripts for major services like CompuServe, GENIE, and MCI Mail. As a fax program, **FAXit** lets you fax directly from any Windows application, schedule when faxes are sent, and save incoming faxes in one step.

Terminal Plus with **FAXit** also supports Microsoft Windows with Multimedia Extensions so you can attach voice or sound cues to communications events. **FutureSoft** uses the **DynaComm** script language for customizing **Terminal Plus** with **FAXit** and fully supports Windows DDE. If you don't use one of the more than 90 fax modems supported, the program also supports ComBIOS (INT-14) network connections.

- List price: *Terminal Plus with FAXit*, \$195. **FutureSoft Engineering Inc.**, 1001 South Dairy Ashford, #101, Houston, TX 77077; 713-496-9400; fax, 713-496-1090.

Circle 415 on reader service card



Terminal Plus has a configurable toolbar.



January 26, 1993
466 Magnum

*"...the most advanced thinking, systems design,
integration, and construction we've seen yet."*

Jim Seymour, PC Magazine, January 26, 1993

A person in a white cleanroom suit and mask holds a large, oval-shaped silicon wafer on a handle. The background is a gradient of blue, purple, and orange, with a dark silhouette of a mountain range. In the top left corner, there are several Micron memory modules.

Micron Means Memory

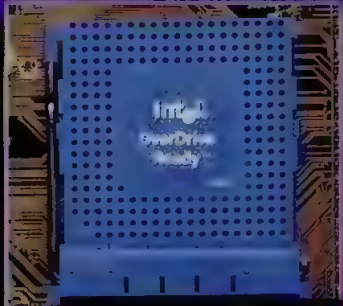
Semiconductors to Systems

Driven by quality, Micron has gained worldwide recognition as a leading semiconductor manufacturer. Founded in 1978, Micron's facilities now span over one million square feet, with more than 4,500 dedicated employees and annual revenues exceeding one-half billion dollars. Quality Micron memory components can be found in everything from personal computers to advanced military applications, giving new dimensions to the words "Made in the U.S.A."

Built on our semiconductor success, Micron continues the legacy by designing high performance systems with the same attention to quality every step of the way. Our unique experience, advanced technology and stringent reliability standards add up to valuable advantages for you and your company. From semiconductors to personal computers, Micron sets the standards by which others are judged.



Micron Means Systems



Pentium™ Ready

At the heart of every Micron 486VL system is a Zero Insertion Force (ZIF) socket designed for Intel's Overdrive™ and Pentium microprocessors. Upgrades are made easily with our "Tool Free" chassis and it's single thumbscrew design.



VESA Local Bus

Micron 486VL systems feature VESA Local Bus compliant 32-Bit high performance video and disk controllers. VL-Bus IDE and SCSI II caching controller options provide up to 50 times faster access with a 400% increase in data transfer rates.



Weitek™ P9000

The Weitek Power 9000 graphics processor produces over 50 Million WinMarks for the ultimate in local bus graphics performance. With 2MB of Micron VRAM standard, you'll get more colors at higher resolutions for photographic quality images

"This cutting-edge piece of technology has accelerated the pace of desktop computing ..."

"... at or near the top of any previous review."

"The Magnum is a solid, competitive package with exceptional performance."

Jim Seymour
PC Magazine



January 26, 1993
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MICRON

Micron Means Business

486VL Magnum

- VESA Local Bus system board
- Intel™ 486™ processor in ZIF socket
- 256K of Micron® 15ns SRAM cache
- 8MB of Micron high-speed RAM
- Edge® VL24 BitBlaster™
VL-Bus 32-bit graphics accelerator
2MB RAM, 1280 x 1024, 16.8M colors
- 14" SuperVGA color monitor
NI at 1024 x 768, .28mm dot pitch
- VESA Local Bus 32-bit IDE controller
- Maxtor® 213MB 15ms IDE hard drive
- Teac® dual media floppy drive
1.44MB 3.5" and 1.2MB 5.25"
- Desktop chassis with five drive bays and "Tool Free" design
- Logitech® mouse and pad
- 1 parallel, 1 game, 2 serial ports
- 101-Key enhanced keyboard
- Microsoft® DOS® 5.0 factory installed

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466•\$2399 466•\$2699
EISA



486VL WinStation

- VESA Local Bus system board
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- 16MB of Micron high-speed RAM
- VL-Bus 32-bit graphics accelerator
Weitek™ P9000, 50 million WinMarks
2MB VRAM, 1280 x 1024, 16.8M colors
- 15" MAG™ SuperVGA color monitor
NI at 1280 x 1024, .28mm dot pitch
- VESA Local Bus 32-bit IDE controller
- Maxtor 245MB 15ms IDE hard drive
- Teac dual media floppy drive
1.44MB 3.5" and 1.2MB 5.25"
- Desktop chassis with five drive bays and "Tool Free" design
- Logitech mouse and pad
- 1 parallel, 1 game, 2 serial ports
- 101-Key enhanced keyboard
- Microsoft DOS 5.0 factory installed

433•\$2599 450•\$2799
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EISA



486VL MagServer

- VESA Local Bus system board
- Intel 486 processor in ZIF socket
- 256K of Micron 15ns SRAM cache
- 16MB of Micron high-speed RAM
- Edge VL24 BitBlaster
VL-Bus 32-bit graphics accelerator
2MB VRAM, 1280 x 1024, 16.8M colors
- 14" SuperVGA color monitor
NI at 1024 x 768, .28mm dot pitch
- VL-Bus 32-bit bus mastering SCSI II controller, up to seven devices
- Maxtor 1.2GB 13ms SCSI hard drive
- Teac dual media floppy drive
1.44MB 3.5" and 1.2MB 5.25"
- Tower chassis with seven drive bays
- Logitech mouse and pad
- 1 parallel, 1 game, 2 serial ports
- 101-Key enhanced keyboard
- Microsoft DOS 5.0 factory installed

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EISA

486VL ValueLine

- VESA Local Bus system board
- Intel 486 processor in ZIF socket
- 4MB of Micron high-speed RAM
- Edge VL24 BitBlaster
VL-Bus 32-bit graphics accelerator
2MB RAM, 1280 x 1024, 16.8M colors
- 14" SuperVGA color monitor,
NI at 1024 x 768, .28mm dot pitch
- VESA Local Bus 32-bit IDE controller
- Maxtor 120MB 15ms IDE hard drive
- Teac 1.44MB 3.5" floppy drive
- Desktop chassis with five drive bays and "Tool Free" design
- Logitech mouse and pad
- 1 parallel, 1 game, 2 serial ports
- 101-key enhanced keyboard
- Microsoft DOS 5.0 factory installed

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486DXL Color Notebook \$2699



- Intel 486DXL 25MHz processor
8K cache and math coprocessor
- 4MB of high speed RAM (to 16MB)
- 80MB removable hard drive
- Color VGA display 640 x 480
- Dimensions: 9.4" x 12.2" x 2"
- Weight: 7.1 lbs with battery
- Suspend / Resume feature
- Full size 86-Key/keyboard
- 1.44MB 3.5" floppy drive
- Advanced Power Management
- 1 parallel, 1 VGA, 2 serial ports
- A/C charger / adapter
- Carrying case included
- Microsoft DOS 5.0 factory installed



Upgrades

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CIRCLE 119 ON READER SERVICE CARD

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Two Great Parents' Guides For Family Fun and Learning

BY CHARLES TAFT

Sooner or later, your child will ask to use the family computer or will ask that you *buy* a family computer. Family computing can be a rewarding and not-so-expensive hobby if you do your homework. Here are two new guides that can help you make informed decisions and get your kids computing.

Robin Raskin, executive editor of *PC Magazine*, and technology writer Carol Ellison have written this year's "buy it" book. Look to *Parents, Kids & Computers: An Activity Guide for Family Fun and Learning* for kids' favorite programs, computing secrets, and imaginative computer activities.

Raskin and Ellison help parents through three major phases of home computing—purchase, preparation, and use—and focus on working with children to creatively explore some of the best kids' software on the market today.

Sharing their own insights (and Raskin's experience raising three computer-literate children), the authors take you on an in-depth tour of several classics—The Playroom, The Children's Writing and Publishing Center, Carmen Sandiego, and Kid Pix—and guide you through LOGO and the kids' sections of Prodigy.

Parents who think that Windows is an adults-only program will enjoy the authors' plan for

personalizing desktops for kids using the Calendar, Clock, Cardfile, Write, and Paintbrush. Minireviews of over 50 programs and sketches of many more round out the survey.

The real value of *Parents, Kids & Computers* is in its ideas for real-life family activities. This makes the book truly useful—not reference-shelf useful, but enjoy-me-at-the-computer

useful. After all, wouldn't you love to be invited to one of the Raskin family's lively international Carmen Sandiego parties?

If you're curious about the wide, wide world of educational

software, turn to Bill and Mary Pride, who share their vast knowledge in *Prides' Guide to Educational Software*. This monumental 607-page book describes, analyzes, and ranks over 750 programs for DOS, Macintosh, Apple II, and Amiga platforms. The book's 50 chapters are organized into 9 parts, 4 appendixes, 5 glossaries, and 2 indexes (getting the idea of the scope of this book?) on buying hardware and software.

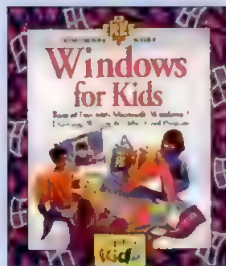
Reviews of educational software from preschool level to college and into adult are arranged by subject matter within topic (preschool, language arts, math, science, social studies, culture, high school, and beyond) and are rated on

■ PC Fun for Ages 8 and Up

While you're busy learning about kids learning computers, the kids can start exploring on their own with the new AlphaKids (800-428-5331) series of activity books. Each delightfully illustrated book costs under \$20 and comes with a software program that disguises PC fundamentals as games. *Fun with Computers* is an activity/coloring book with a program that teaches shapes and colors. Kids can practice touch typing with *Tic Tac Type*, paint with *PC Picasso*, build a database of friends' addresses with *DataMania*, and track allowances with *MatheMagic*.

Building with BASIC explains programming concepts, and *Windows for Kids* turns Windows' accessories into an electronic playground.

As a bonus, your child is entitled to a free membership in the publisher's Kids' Club, a subscription to a club newsletter, kids' disk labels, and other neat surprises.—C.T.



a scale of 1 to 5 on concept, usability, and educational value. The Pride parents and their eight kids have tested each program, and the thorough reviews and commentary reflect both their experience and opinion.

Prides' Guide is a treasure trove of educational software. If you're looking for a program to introduce your 2-year-old to the solar system, assist your 6-year-old in producing a puppet show, or teach you how to write your

own Great American Novel, you've got the right book. And in addition to reviewing major disk, video-disc, and CD-ROM titles, the Prides look at smaller companies' offerings and earmark programs for home schooling, remedial education, and special needs.

The Prides call them as they see them, and though you may not always agree with their opinions, you will certainly

appreciate their product descriptions and dedication to seeking programs that meet their own family's standards.

Both these books offer expertise and encouragement to help you discover the magic of family computing. Read *Parents, Kids & Computers* to learn how to maximize some of the most popular kids' software today, and turn to *Prides' Guide* for an exhaustive source of educational software. □

• **Parents, Kids & Computers: An Activity Guide for Family Fun and Learning**, by Robin Raskin and Carol Ellison, \$20. Random House Electronic Publishing, 201 E. 50 St., New York, NY 10022; 800-733-3000. ISBN: 0-679-73910-6.

Circle 456 on reader service card

• **Prides' Guide to Educational Software**, by Bill and Mary Pride, \$25. Crossway Books, 1300 Crescent St., Wheaton, IL 60187; 800-346-6322. ISBN: 0-89107-665-4.

Circle 457 on reader service card



Why people who k aren't going anyw

Over 18 million people use some version of Lotus® 1-2-3™ every day. They depend on it. They trust it. They know it. Which is why, if they're moving from DOS to Windows™, they're moving to 1-2-3 for Windows...for some very good reasons.

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They know that 1-2-3 offers the *best* 3D technology.

Only 1-2-3's 3D technology gives you easy access to 256 worksheets and lets you build 3D formulas just like you do in 2D. Which ultimately makes consolidating, comparing and analyzing data much simpler. In comparison, Excel's Workbook™ is a limited imitation of true 3D. And while working in Group Mode in Borland's® Quattro® Pro for Windows, simply cutting a range of data in one sheet unfortunately means you'll delete the data on every sheet. And what's worse, you can't undo it. All of which means if the analytical power of 3D technology is important to you, 1-2-3 is still the best choice you can make.

They know that 1-2-3 for Windows now includes the *most* asked-for enhancements.

The new release of 1-2-3 for Windows Release 11 includes a number of performance enhancements. For example, it's now the fastest Windows spreadsheet for printing on PostScript® printers. And it's also the fastest to launch. We've also added over 25 innovative new features, usability enhancements and GUI development tools. The result? 1-2-3 for Windows is now more powerful and easier to use than ever before.

They know that 1-2-3 for Windows offers *unmatched* database capabilities.

It's true. If you're a spreadsheet user who needs to access external databases, 1-2-3 for Windows remains unmatched—particularly if you need relational capabilities. In fact, *Corporate Computing* (August 1992) recently wrote that “for the experienced 1-2-3 database user, 1-2-3

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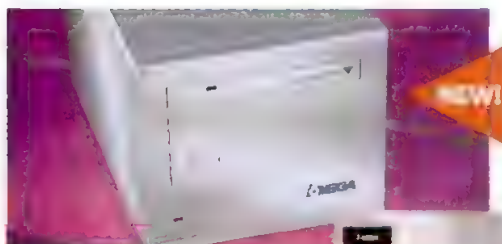
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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

PARTS: An Innovative OS/2 Development Environment

BY SHERYL CANTER

At \$1,995, Digitalk's PARTS Workbench is not cheap, but its visual development system is so cleverly designed that you need only minimal programming knowledge to create high-level OS/2 applications quickly. And if you don't mind writing some code, PARTS is flexible enough to handle any task. It's only available as a 16-bit application at the time of this writing, but a 32-bit version should be shipping by the time you read this. Registered users of the 16-bit version will receive the 32-bit version free of charge. Digitalk plans to release a Windows version of PARTS sometime in the first half of 1993.

PARTS stands for Parts Assembly and Reuse Tool Set. Sixty-six *parts*—prewritten, reusable code modules—are included with the product. These parts can be either visual or nonvisual. Visual parts are user interface objects such as buttons, dialog boxes, and data entry fields. Nonvisual parts are actions such as file access, printing, and DDE (Dynamic Data Exchange). Parts can be modified or combined with other parts, but if you want to create a completely new part, you'll need to use a full-featured programming language. A wrapper that lets you create new parts in C or Smalltalk is included in this release; a wrapper for creating parts with Microfocus COBOL

is scheduled to be released by the first quarter of 1993.

USING THE MOUSE TO BUILD A DATABASE

The best way to describe PARTS is by building an application. The first step is to drag a window object (for the user interface) from the Catalog to the Workbench where it can be moved, resized and customized. The Catalog is an OS/2 notebook object, and can be moved around as needed. Icon-labeled tabs let you quickly access the category of interest, and the parts themselves are also represented as icons.

None of the icons in the Catalog or the Workbench toolbar are easily identifiable. However, when you place the mouse cursor over an object or icon, a message describing its function is displayed in a status bar along the bottom of the Workbench. The one exception to this is Tab icons; no messages are displayed for them, you just have to learn them.

After building the interface, you can drag nonvisual parts to the Workbench area and drop them somewhere outside the user interface window. For example, if you were creating a database, you might choose a Btrieve part. Then you establish a connection between the user interface and the

Btrieve object by holding down the left mouse button and drawing a line between the two objects. A dialog box opens, prompting you to tell PARTS what event the link represents, and what message to generate when the event occurs. You select events and messages from a context-sensitive list. If the predefined list is inadequate, you can define new events and messages, and add them to the menu. You create new events and messages with a scripting language called PARTStalk, a subset of Smalltalk.

You need two links between the user interface part and the Btrieve part. The first link tells PARTS to open Btrieve when the interface is opened; the second says to close the database when the interface is closed. At any point during the construction of your application, you can test out how everything is working by selecting Launch from the bar menu, or pressing

applications as standalone applications, provided you include the necessary DLLs; there are no royalties.

A NEW PARADIGM

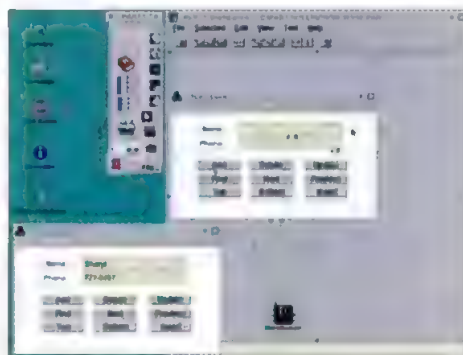
If you're not a programmer, drawing lines and selecting actions is an easy way to build an application. But if you're used to writing code, this is not an intuitive model. For example, in PARTS, to tell your application to make a calculation that depends upon the result of a previous calculation, you must make a *result link*, drawing lines from field to field. In a traditional program, however, one calculation simply follows another—a more intuitive approach.

Nonetheless, professional developers will appreciate the complex parts, such as the DDE part, since these eliminate the task of writing hundreds of lines of code. And as wrappers for more languages are developed, PARTS will be able to serve as an integration tool that can put a snappy new face on a company's old code. Digitalk encourages third-party development of parts through a developer support program. With the availability of more parts from Digitalk and third-party vendors, this innovative development environment is just beginning to show its potential. □

• PARTS Workbench, Version 1.0

List price: \$1,995. Requires: OS/2, Version 2.0 or higher (which implies a 386-based PC or better), 12MB hard disk space, 8MB of RAM. Digitalk Inc., 9841 Airport Blvd., Los Angeles, CA 90045; 310-645-1082.

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To see the results of changes you make in your PARTS OS/2 application, you simply relaunch the application.

the Launch icon on the toolbar. Thanks to the multitasking capabilities of OS/2, you can test out your application in one window and modify it at the same time in another window. To see the results of your changes, simply relaunch the application.

You can distribute PARTS

NO OTHER PEN HAS THIS KIND OF

The 3.3-pound machine is considerably lighter than many competitors' machines. Its black-and-white screen uses a back light,

which will allow customers to use the computer in difficult lighting situations.

— Los Angeles Times, Nov. 2, 1992

...values for ...
connections, they said.

One problem we've had is seeing the screens [of other pen computers] in various lighting environments...[Toshiba is] using new backlit reflective technology; you can see it in any lighting.

— Reprinted from PC Week, Sept. 14, 1992

...users said.

[Toshiba has] done an exceptional job in the industrial design of the system, and going beyond that, looking at specific vertical solutions.

See TOSHIBA page 103

— Stella Kelly, InfoCorp Senior Analyst
Infoworld, Nov. 2, 1992



The Toshiba Dynapad makes most of its predecessors look clunky by comparison. Packed into this sleek, little 3.3-pound tablet is a 9.5" transreflective-sidelit display, 40MB hard drive and two PCMCIA 2.0 slots. Clearly a 3rd-generation pen computer, the innovative engineering in pen market has

— Portia Isaacson, Dream IT, Inc.

INTRODUCING THE TOSHIBA DYNAPAD

INK.

[Toshiba has] a much better infrastructure for providing support than some other pen computer companies.

—Tim Bajarin, President/Creative Strategies Research International Inc. Infoworld, Nov. 2, 1992

[The Dynapad is] a nice system, has a good feel and [Personal Computer Memory Card International Association] cards, and at that low weight, it's much more the kind of thing people are going to need in the field than something like the ThinkPad.

—Janet Cole, Dataquest Analyst Computerworld, Nov. 2, 1992

I've been saying that [a pen computer] needs to be small, rugged, and able to run 386 or better.

—Mel Hinton, Senior Engineer/Public Service Electric and Gas Co. Infoworld, Nov. 2, 1992



Amazingly, we've even been able to incorporate two PCMCIA slots for expandability.



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We gave our pen a transreflective display screen so it can be used in a variety of different locations and lighting conditions (underground, at night, in broad daylight).

Leave it to Toshiba engineers to create a pen computer that has left an indelible impression on the computer world.

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PAD T100X

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Michael J. Miller

Bought Any Software Recently?

Can you name one multibillion-dollar industry that had double-digit growth in 1992? A business that racked up over \$4 billion in sales in the first three quarters of last year, an increase of 17 percent over the previous year? If your guess is the

software business, you're right on target.

Judging from the mood of industry naysayers, though, you'd think that the software business—with the exception of Microsoft and possibly Novell—is in deep trouble. The pessimists point to two observations: The market is slowing down, and prices are falling. While there is some truth to both of those points, the software business remains very competitive and continues to hold plenty of opportunity. Why? Because, I believe, we've barely even begun to tap the full potential of personal computer technology.

In a recent report on the industry's health, the Software Publishers Association points to some optimistic indicators. The SPA collects revenue figures from the major software firms through an independent accounting firm, although it does raise them to reflect retail prices.

SLICING THE SOFTWARE PIE

While the numbers aren't as promising as those of past years (the market grew 25 percent from 1990 to 1991 and 26 percent the year before), sales are still very good at home and are growing even faster overseas. International sales were up 20.6 percent in the first nine months of 1992. There aren't many industries today with this kind of growth.

A closer look shows that this growth is not consistent across product categories. Windows software accounted for \$1.3 billion of the total, up 118.5 percent from a year earlier. As this market expands, however, its growth rate shows signs of slowing down considerably. While DOS software is still the largest piece of the pie, it's shrinking, down 11 percent from 1991.

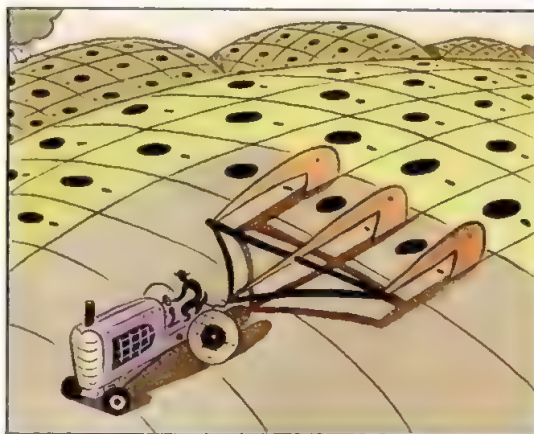
These figures may just confirm the troubles many software companies are facing and the continued dominance of Windows applications. But let's drill down even farther. Although Windows applications are doing quite well in some categories, DOS applications continue to reign in others. Windows dominates in word processors, spreadsheets, presentation graphics, and drawing and desktop publishing applications. Word processors and spreadsheets account for nearly half of all Windows sales. Microsoft's Word and Excel dominate these categories, along with WordPerfect and 1-2-3 for Windows.

But there's more to the story. While Windows is clearly gaining on the 12-year-old DOS market, there's still a lot of life in DOS. With \$1.9 billion in sales in the first three quarters of 1992, DOS applications still account for the largest single segment of the software market. The vast preponderance of database, financial management, home education, and entertainment software remains DOS-based.

While the emergence of Windows-based databases may fuel an even larger migration to Windows, a major release of WordPerfect, Microsoft Word, or 1-2-3 for DOS could also breathe life back into the DOS market.

Just about every company I've talked to—except Microsoft—says the price war is on, and just about everyone blames their competitors. The SPA confirms the existence of a price war, reporting that the average price of an application has declined from \$189 to \$152 since 1989. Great news for consumers.

But these numbers don't take into account the changing dynamics of the market. Not too long ago, almost all software was



Lower prices have slowed revenue growth in the software business, but people are still buying in a big way.

Michael J. Miller

purchased by new users. Today, upgrades account for a large part of the market, going to either existing customers or users of competitors' products, in which case they're "competitive upgrades."

In the long run, I can see the emergence of an annual fee covering updates, service, and support. But it's important that vendors charge enough to cover support, service, and continued upgrades or they won't stay in business for long.

One thing saving the industry is that companies are shipping more actual units of software. The SPA reports that about 30 percent more units were sold in the third quarter of 1992 than in the same period of the previous year. Two factors seem to account for this growth: More PCs are being sold, and more people are running multiple applications.

PIRACY HURTS

Unfortunately, the numbers also indicate that software piracy is still a problem. By

now, everyone should know that software piracy is wrong. It especially hurts the smaller software developers, who may need the resources to develop future versions of their program.

According to the SPA's latest study on software piracy, one program in five is an illegal copy. That represents a loss of an estimated \$1.2 billion in 1991 alone. But there is some good news to report as well. The loss was \$2 billion in 1990. The SPA projects that 78 percent of all software obtained by end users in 1991 in North America was purchased, as opposed to 63 percent in 1990 and a mere 52 percent in 1989. This reflects a lower piracy rate than anywhere else in the world. Nearly every country shows more PCs sold than software packages sold—a classic indicator of piracy.

Still, a piracy rate of 22 percent is too high. The SPA calculates that it represents, in addition to over \$1 billion in lost sales, a loss of 60,000 full-time jobs, from programmers to retail clerks. However, I believe that the rate is even higher, because the calculation the SPA uses assumes an average of only three applications per user. The real number is probably higher, in which case piracy is even more rampant.

VERTICAL SPIN

There's no doubt that people are buying more software and are running multiple applications. This is good not only for software developers but, more importantly, for users. Today's operating environments let us run multiple programs, and over the next few years we'll be working with programs that are better integrated. There's plenty of opportunity for developers to offer customizable vertical programs that build on primary applications. Programs that add accounting, legal, or medical features to standard word processors, spreadsheets, and databases are just some examples of this future software niche.

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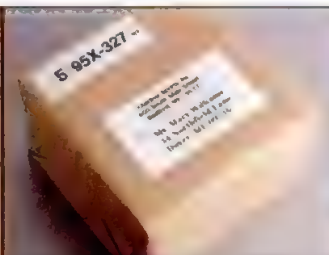
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1991



1991



1992

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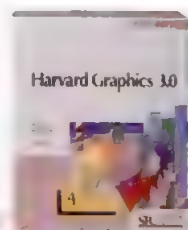
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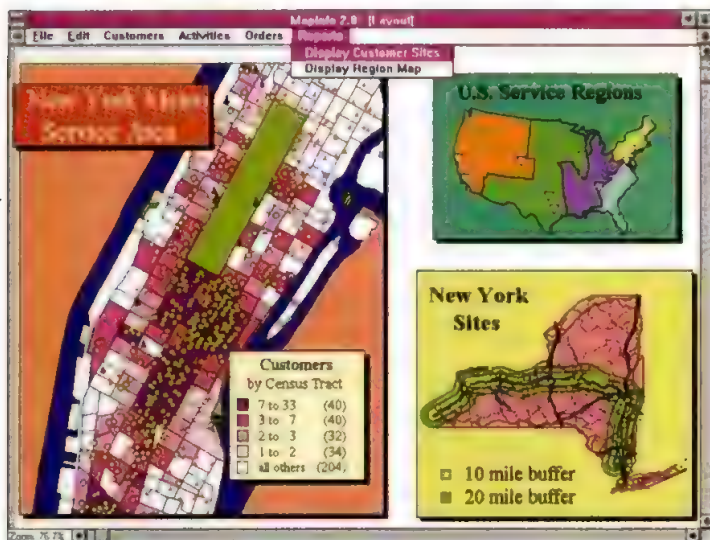
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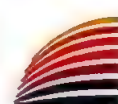
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Bill Machrone

Benchmark Test Progress

Winmarks. SPEC. DOSmarks. iCOMP. Whetstones. Dhrystones. Whatever happened to good old megahertz? Wasn't there a time when you could just ask what the clock speed was and know how fast the machine would be?

Yes, there was such a time. Unfortunately, it was 1984, before IBM shipped the 80286-based PC AT. Virtually all DOS machines were based on the 4.77-MHz 8088. A few rugged individualists offered 8086-based machines at higher clock speeds, but concern over compatibility was rampant, and the machines never gained wide acceptance. The 286 changed everything: Even at a conservative 6 MHz, it was about three times as fast as an 8088. Unlike 8088s, 286s were offered in many clock speeds: 6, 8, 10, and 12 MHz, with one ill-starred shot at the 16-MHz brass ring. The relationship between clock rate and performance was linear—nice and clean.

The 386 and 486 have caused similar dislocations from the simple world of the 8088, and the various SX designations have added to the confusion. The Pentium processor and its variants will add another level or two. We've moved from subscalar to scalar to superscalar performance, which is a fancy way of saying that the old chips perform less than one operation per clock tick, the 486 performs one operation per tick, and the Pentium performs each operation in less than one tick. All of which conspires to make megahertz meaningless.

Other performance enhancers, such as caching and video coprocessing, conspire to give you a subjective sense of speed. The way these subsystems interact is the province of application-based benchmark tests, where you find out how fast the system can run your applications. But these benchmark tests don't isolate the components causing the speed boost (or bottleneck) unless you run them repeatedly while switching components—a time-consuming process at best.

I've mentioned the role of profiling and component benchmark tests pre-

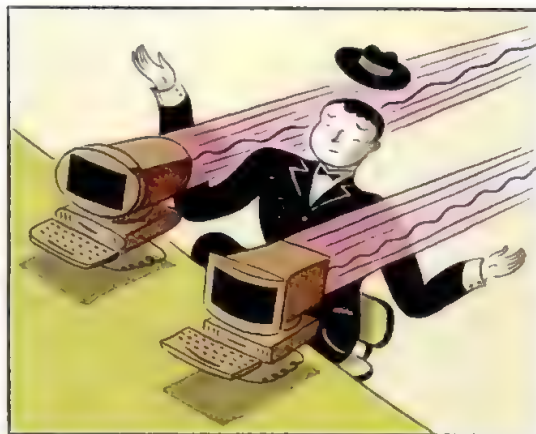
viously ("Lies, Damned Lies, and Benchmarks," October 13, 1992). Now let's look at a couple of the newest benchmark tests and what they really tell you.

iCOMP, YOUCOMP...

Intel has recently introduced iCOMP (the Intel Comparative Microprocessor Performance index), which it has begun to use in marketing its processors. The iCOMP number is Intel's way of addressing the profusion of processor types and the resulting confusion as to how they stack up in sheer performance. Intel research shows that customers are confused by the differences among 386, 486, SX, DX, and DX/2 at all the available clock rates. iCOMP combines standard instruction-mix, integer, and floating-point tests to come up with a number that does a pretty good job of showing the processor's relative performance. Every processor is referenced against a 486SX/25, which has a value of 100. The best thing about iCOMP is that it allows you to compare across processor families and manufacturers.

Some manufacturers dislike it because they fear that customers will use it to rate overall system power rather than just the processor. iCOMP gives a horsepower rating, plain and simple. And although the car with the biggest engine is likely to be the fastest, there are exceptions.

If you are concerned with graphical performance, you should always opt for the fastest processor. It will have a high iCOMP number, but that tells you nothing about the quality of the motherboard design, the speed of second-level cache memory, the performance of the disk subsystem, or the video card, any of which may be a severe bottleneck. To properly gauge



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Bill Machrone

the effect that subsystems have on overall performance, you have to run application or component benchmark tests.

GRAPHIC DESCRIPTION

Our own Graphics Winmark scores are derived from a subset of Winbench, the most comprehensive set of Windows tests currently available. In the latest version, released at Fall Comdex, we combine 12 of the graphical operations most frequently used in Windows, such as memory-to-screen source copies, pattern copies, single lines, polylines, text output, and area fills. We analyzed the most popular Windows applications to find the frequency with which these operations occur and created the weighting factors we use to combine the scores for individual operations into a single Graphics Winmark score.

Winbench has been around for a while, and many graphics board vendors advertise their Winmark scores. If you consult these numbers and compare them with scores published in *PC Magazine* or any other Ziff-Davis publication, make sure you're comparing apples with apples. The current version of Winbench is 3.1, but as of this writing, many manufacturers are still quoting results from Winbench 2.5. The two numbers are *not* comparable.

Remember, the Winmark scores are based on our profiling of the most popular Windows applications. Increased Winmark scores correlate highly with increased performance in workaday applications. In running our underlying application tests on a wide range of systems and configurations, we found that the best graphics accelerator is a faster processor. Not that the video board manufacturers are deceiving you, but no video board—even coprocessed—will make a 386/25 perform like a 486. The best graphics cards simply let the processor do its thing with the fewest obstructions.

One caution: If you look at other test suites, examine the underlying architecture. Several are based on applications' macro facilities. This is one of the least desirable ways of measuring Windows performance, because you wind up measuring the performance of the macro subsystem, not the application. There will always be room for healthy disagreement in benchmark testing, but for you, the buyer, the playing field has never been quite so level, nor the information so highly tuned to your needs. □

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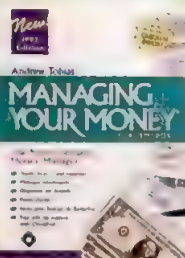
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The only notebook with a tilt & swivel display. Great for sharing data or keeping it private. Easily adjusts for perfect viewing.



Buy with confidence. ZEOS just won PC Magazine's Readers' Choice for Service & Reliability (Feb. 9, 1993). We're the only PC vendor to earn the "Excellent" rating for both our lap-top and desktop systems!



Digital brightness and contrast buttons make screen adjustment so easy.



ZEOS® Freestyle/SL. More features at a lower cost than any other notebook.

To try and compare the new ZEOS Freestyle/SL to any other notebook is next to impossible. Because nothing else has all its features. And even with all these great features, nobody can match the price. Features and price. It would seem the new ZEOS Freestyle/SL is the best of all worlds. It is.

DESIGNED BY USERS. JUST LIKE YOU!

We asked our customers what it is they want in the perfect notebook. The first thing they told us is that most notebooks look like a cigar box with a lid. They told us they wanted not only good looks, but things like great power and great battery life. Lightweight too, like five pounds and change. And the keyboard should be effortless to use. The entire product had to be extremely durable. And that was just for starters.

SL POWER. SL BATTERY LIFE. 64K CACHE!

We listened well.

Then we got down to work. For the chipset and CPU we selected the Intel 25MHz SL. We then built in a high-speed 64K SRAM cache as standard. We know this system might well replace a desktop for many users.

And power to your ZEOS Freestyle/SL system is provided by our advanced battery system. The fully enclosed lightweight battery packs easily snap in and out and can be "quick-charged" when the system is not being used or trickle-charged when in use. So what happens when the power is on?

GREAT VIDEO TOO.

You get great video! Because for video control, we chose the amazing new Cirrus Logic VGA controller. It not only consumes less power, it also produces the fast crisp images you're looking for. And with a business machine like this you'll also appreciate our dual display capabilities. You can connect an external VGA color monitor for simultaneous co-display. And that's not all.

Period.

A NOTEBOOK KEYBOARD YOU'RE GOING TO LOVE.

We re-designed and re-sculpted every key from scratch. Even the key-switch mechanism was invented anew. And we added the mouse key for easy cursor control. It is the

absolute perfect notebook keyboard. What else?

Lots else! Like the best display system of any notebook available anywhere. We listened here too. The screen is big and easy to read. Plus, it's high contrast and it's fast. It's also very easy to adjust. People said contrast and brightness knobs were hard to use. So we replaced them with soft touch buttons that *electronically* adjust screen settings at your command. Then we really got creative.

THE ONLY NOTEBOOK WITH A TILT & SWIVEL DISPLAY.

Can you imagine your desktop PC without a tilt and swivel display? Neither

could we. So why not incorporate that feature into a notebook. With the ZEOS Freestyle/SL notebook you can adjust the screen left and right as well as tilt it up and down. Now you can truly adjust your notebook screen to the perfect viewing angle.

IT FLOATS TOO.

And then there is the "floating" screen. When you're facing your new ZEOS Freestyle/SL, the screen actually appears to "float" in the air in front of you. It's the only notebook that can really be used sitting on your lap!

EXTRA, EXTRA, EXTRAS. READ ALL ABOUT 'EM!

We've made more options available than ever before. Like our modem with send/receive fax. And memory up to 20MB, hard drives to 180MB, even an optional Italian leather carrying case! Extra batteries and a charging stand are available too. Call 800-554-7172 for all the details.

2MB, 60MB Only \$1695!

Built-in mouse key provides easy cursor control. Leave those bulky mice behind!



This sliding port door won't break off or come loose. Saves your fingers too.



ZEOS. #1 RATED NOTEBOOKS, SERVICE & SUPPORT!

PC Magazine recently surveyed notebook users for their Service and Reliability issue. Their findings? "Only ZEOS portable PCs achieved significantly higher-than-average ratings in all four categories." The categories were reliability, future purchase plans, repair service satisfaction and technical support. And remember, ZEOS technical support is 24 hours a day, 365 days a year, toll free. And we back your new ZEOS Freestyle with our 30-Day Absolute Satisfaction Money-Back Guarantee, One Year Limited Warranty and more.

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Ordering your new ZEOS notebook is easy. Simply pick up the phone and give us a call. A friendly ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS notebook. Give us a call!

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800-554-7172

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X202 PCM 9303A

CIRCLE 125 ON READER SERVICE CARD

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- Intel 25MHZ 386SL, 64K cache
- 2MB RAM standard, expandable to 20MB.
- 60MB hard drive, options to 180MB, 3.5" 1.44MB floppy.
- Backlit 9½" VGA display with Tilt/Swivel base. Simultaneous display with external VGA monitor.
- Snap-in and -out battery packs provide for a real 3-4 hours of typical operation or even longer depending on your applications.
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- 8.5" x 11.3", 5.6 pounds, built-in soft carrying handle.
- 81-key keyboard with built-in full-size inverted "T" arrow keys.
- Serial, parallel and VGA ports with standard connectors protected by a durable, easy-to-use sliding door. No more broken doors or broken fingernails!
- Includes DOS 5.0!
- 30-Day Money-Back Guarantee. One Year Limited Warranty. ZEOS Customer Satisfaction Package.
- Loads of options. Modems, carrying cases and more!
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Open 24 Hours a Day,
365 Days a Year!



FINALLY...AN AFFORDABLE COLOR NOTEBOOK.

Choose your package—or we can custom-build to your specifications!

PACKAGE #1 ONLY \$2495

- 386SL-25 MHz CPU with 64K cache.
- 2MB RAM.
- 80MB high-speed IDE hard drive.
- Built-in high-density (1.44MB) 3.5" floppy drive.
- High-res 640x480 passive matrix color VGA LCD.
- A slim 8½"x11½" total system weighs only 6.7 lbs. with battery!
- Light, slip-in, slip-out NiCad battery. A whopping 2.5 hours of battery life typical; more with power management.
- Trickle-charge or one hour quick-charge. Extra battery packs available.
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- When battery runs low you can change batteries without having to shut off the system!
- 85-key keyboard with embedded numeric keypad, 12 dedicated function keys, and true 101-key emulation. Inverted "T" cursor layout.
- Serial, parallel, keyboard and external video ports.
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- 30-Day Absolute Satisfaction Money-Back Guarantee and complete ZEOS Customer Satisfaction Package.
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PACKAGE #2 ONLY \$2995

Load up your Notebook! We've included free software, internal send/receive fax modem and more...an incredible value!

- 4MB RAM.
- 80MB IDE hard drive.
- Internal send and receive fax modem.
- Custom-fitted carrying case.
- Genuine Microsoft Mouse.
- MS-DOS 5.0, Windows 3.1, the new Lotus Organizer, and your choice of either Lotus 1-2-3 for Windows, Ami Pro or Freelance Graphics for Windows.

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Go to 8MB of memory, 130MB hard drive, extra battery...this could be the only PC you'll ever need!

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- 130MB IDE hard drive.
- Internal send and receive fax modem.
- Custom-fitted carrying case.
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- Genuine Microsoft Mouse.
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Remember what a difference it made when you switched to a color desktop?

With the ZEOS Color Notebook, you'll enjoy vivid colors from a palette of 256 on your full-size 9.5" display. And there's more.

✓ Fast drives and loads of storage with hard disk right up to 130MB. ✓ Unbelievable 25MHz SL performance, coupled with our 64K built-in cache. Standard. ✓ Up to 20MB of high-speed RAM for the most demanding applications. ✓ A built-in high density 1.44MB 3.5" floppy drive. ✓ Serial, parallel, external VGA and keyboard ports. Use your system as a desktop PC too! ✓ Send and receive fax/modem available, so you can always stay in touch. And that's not all.

THE INTELLIGENCE OF THE 386SL CHIP

Intel designed the new 386SL processor specifically for notebooks. And they were right on target! You'll find that this sharp new processor extends your battery life significantly because it's intelligent enough to power-down the memory, disks, modem, and more when they're not in use. It's perfect for the stop-and-go computing that you're likely to do every day.

MANAGE YOUR POWER.

Or if you're working non-stop, you'll get even more out of the battery by using the programmable power management features. And here's another really neat benefit we know you'll love. You can change batteries without having to shut off the system! You can even use Suspend/Resume when you're working in Windows. Speaking of Windows...

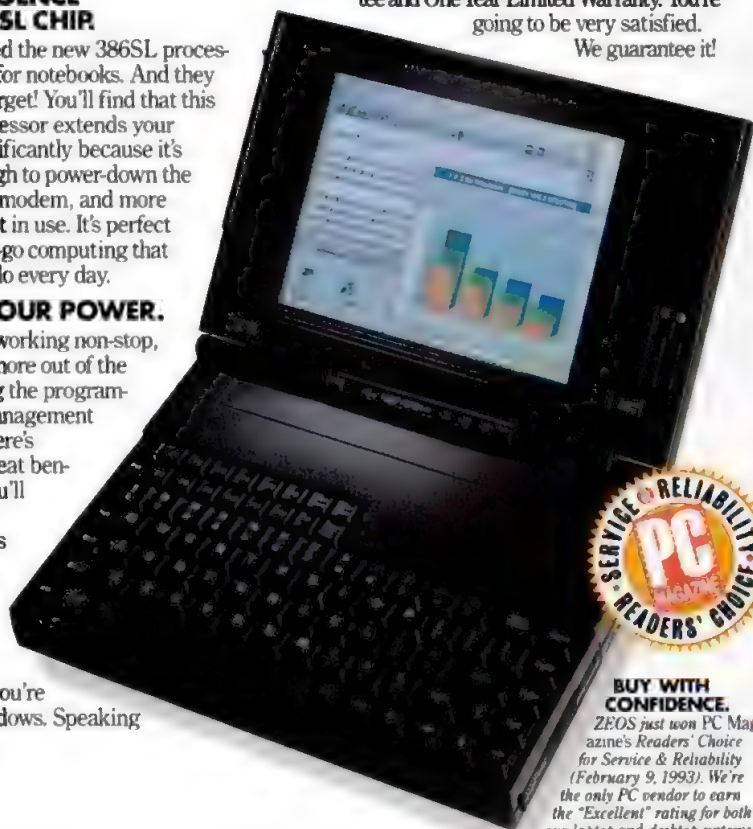
FREE LOTUS SOFTWARE.

We don't just stop with great hardware. In packages 2 and 3 we're giving you—absolutely free—your choice of either Lotus 1-2-3, Ami Pro or Freelance Graphics. And that's in addition to DOS, Windows, and the new Lotus Organizer—the personal information manager highly recommended by *PC Magazine*. With all the free software you get from ZEOS, you save hundreds of dollars!

WE'RE HERE FOR YOU 24 HOURS A DAY.

Buying from ZEOS means you also receive our award-winning after-the-sale support and service: 24-Hour-a-Day Toll-Free Technical Support, 365 days a year. You also receive our 30-Day Absolute Satisfaction Money-Back Guarantee and One Year Limited Warranty. You're going to be very satisfied.

We guarantee it!



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CIRCLE 038 ON READER SERVICE CARD





John C. Dvorak

Lotus, Move Forward or Die!

Lotus 1-2-3 is the Apple II of software, and it's about time that Lotus faced the fact. Lotus's future is in the technologies developed by its in-house coders of Improv, the dynamic and fresh model for the new century's spreadsheets.

Improv was originally coded for the NeXT machine and has recently been ported to Windows. Insiders expect the Windows version to ship in the first or second quarter of 1993. It should be an incredible success if marketed correctly.

Unfortunately, it looks as if Lotus is internally hogtied by an infrastructure of 1-2-3 diehards the same way Apple was nearly strangled by Apple II loyalists. Luckily, Steve Jobs at Apple had a personal stake in sinking the Apple II and pushing the Macintosh forward. There's no evidence that Jim Manzi at Lotus has the same drive or motivation to get Lotus out of its rut. The company's tombstone will read "1-2-3 and out!"

Lotus was the king of spreadsheets, and was rightly the leader, as it dominated the entire market. Disregarding Improv, nobody would call Lotus a leader in the field it pioneered anymore. People would cite Excel or Quattro Pro as the leading spreadsheet program.

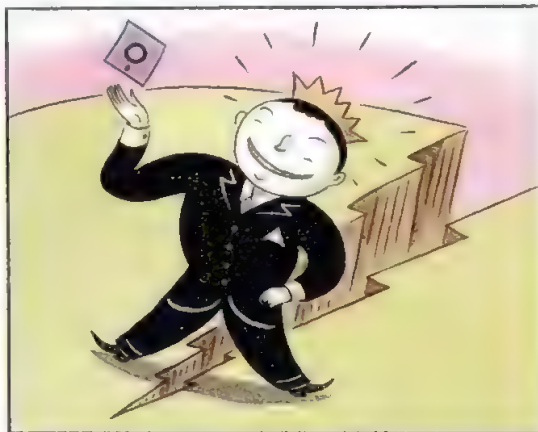
The long-term winner in this battle is Microsoft, which can unload Windows *plus* Excel for such a low site-license price that few companies can resist. And why should anyone care that they're using Excel as opposed to 1-2-3? Spreadsheets are pretty much the same, aren't they?

Not really, if you throw the dubiously named Improv for Windows into the batch. This is a completely new and modern model for spreadsheets. There is not one person in the industry who will say a bad thing about Improv. It introduces a great new concept: It releases the user from the rigidity of cell locations as variables. Don't read about it. Get a demonstration. It's clearly the easiest spreadsheet to edit and restructure.

Furthermore, neither Microsoft nor Borland has

anything like it. It could trigger a new spreadsheet revolution and put Lotus back on track in its core business. Unfortunately, Improv competes with 1-2-3, and this upsets a large contingent of middle managers and dinosaurs within Lotus who will fight for their turf. On a recent trip to London I was amazed to find out that the 1-2-3 cabal is so thick within the company that efforts to promote other products overseas are met with increased resistance.

Only recently has Lotus done much promotion of non-1-2-3 products. Magellan was given an early boost, then left to languish. Lotus still doesn't know how to sell its pioneering program, Lotus Notes, and Agenda has already been shelved. Now there's a rumor that any salesperson going to a company to demonstrate Improv must take a watchdog from the 1-2-3 group along to make sure nothing bad is said about 1-2-3. Whether or not this is true, the 1-2-3 cabal apparently had its way at Comdex, too, with Improv being shown at one lone station in the farthest reach of the booth. If Borland or Microsoft had this technology, it would have been the highlight of the vendor's booth.



Lotus's Improv could trigger a spreadsheet revolution—if the company doesn't derail it first.

Lotus has been showing signs of life, with effective new advertising for its business graphics products and other core products. Still, the evidence is mounting that the marketing of Improv will be sheepish as the bureaucracy at Lotus finds a way to derail a fabulous product. This product is Lotus's Macintosh, just as 1-2-3 is its Apple II. Imagine where Apple would be if it were still pushing the Apple II line and leaving the Mac to languish. I hope Lotus will bet the company on the future and retake its rightful position. The way Apple did.

Ami Pro gives Word and WordPerfect what they've never had before.

Features	Ami Pro 3.0	Word for Windows 2.0b	WordPerfect for Windows 5.1
True WYSIWYG in all views eliminates guesswork	Yes	No	No
Fast Format – quick repetition of text formats	Yes	No	No
SmartMerge step-by-step mail merge guide with a card file data manager	Yes	No	No
Preview of Style Sheets for memos, faxes, newsletters, etc.	Yes	No	No
WYSIWYG preview in File Open to quickly view, print, or extract text	Yes	No	No
More import/export filters	45	27	37
On-line Tutorial	Yes	Yes	No
Automatic re-numbering of lists	Yes	No	No
Customizable, editable, sizable, colorful SmartIcons™ for one click access to frequent tasks	Yes	No	No
In-context editing of drawings and charts	Yes	No	No
Laptop install option for quick and minimal configuration on a laptop	Yes	No	No

Something to shoot for.

Take a look at this chart and you'll see, feature-by-feature, just how far Ami Pro® 3.0 has leaped ahead of other Windows™ word processors.

Ami Pro 3.0 takes top honors.

In fact, in recent tests† conducted by the National Software Testing Laboratories, Software Digest® (Vol. 9, No. 6, Sept. '92) gave Ami Pro 3.0 the highest Overall Evaluation in its category.

Their reason: "Lotus Ami Pro 3.0 offers an unbeatable combination of peerless usability, top-level features and fastest overall performance."

It also received the highest score ever for a

Windows word processor in a recent InfoWorld® review, and won the PC Computing MVP award for word processing. So it's definitely the word processor to evaluate.

Now that you've seen the evidence, why not prove it to yourself? Call us at **1-800-872-3387, ext. 8368** for your free working model or to upgrade from your current word processor for just \$129*.

Try Ami Pro 3.0. And see why we've developed such a following.



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Ami Pro 3.0

Word Processor for Windows

†Among Windows word processors tested. Reprints of report available upon request. *Offer expires 3/31/93. Call for a list of eligible word processors. Education-priced Lotus products not included. Offer valid in U.S.A. only. Not to be combined with any other offer. Please have your credit card and current word processor ready when you call. In Canada, call 1-800-GO-LOTUS. © 1992 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. All rights reserved. Lotus and Ami Pro are registered trademarks and SmartIcons is a trademark of Lotus Development Corporation. Software Digest is a registered trademark of NSTL, Inc. InfoWorld is a registered trademark of InfoWorld Publishing, Inc. WordPerfect is a registered trademark of WordPerfect Corporation. Adobe Type Manager and the ATM logo are registered trademarks, in the United States, of Adobe Systems, Inc.

CIRCLE 143 ON READER SERVICE CARD

Inside Track

W

hither CD-ROM Dept.:

Hot! 1993 appears to be the year that CD-ROM will become popular, viable, and profitable. The new approaches to delivering info will be thematic. The

best example of new thinking comes from ZCI (214-880-0102). The company, founded by author/lecturer Paul Zane Pilzer, has developed a new engine and multimedia system that is a perfect fit for educational use of CD-ROM technology. While the subject matter of the first disk, unfortunately, is mostly that **personal-growth** blather, the engine is a unique blend of text and voice that I found compelling. If you have anything to do with text-based CD-ROM, then you should look at the way it's handled here.

The first offering is called Multimedia Powertalk, and it contains two books by late-night infomercial pitchman Tony Robbins and two by Pilzer himself. More interesting is a multimedia interview of Pilzer by Robbins in full stereo with read-along text, hyperjump capability, and **flashing** graphics. After the \$79.95 Multimedia Powertalk CD, which is largely a marketing exercise, ZCI plans to roll out CD-ROMs on JFK (with a hypertext version of the Warren Commission Report), **Malcolm X**, and Martin Luther King, Jr., ranging from \$19.95 to \$29.95 per disk.

I must mention the CD-ROM packaging **vendor** used by Pilzer. Reynard CVC is a New Jersey-based developer of a CD-ROM jewel case that is **unique**. In fact, it's simply the best I've ever seen. The CD-ROM slips in sideways on a special carrier that folds open when you pull on it. It's **hard to explain**, but I'd advise anyone thinking of publishing a CD-ROM to call Arthur Herr at 201-567-8998. This guy has invested his life's savings in a first-rate invention. A **hot**, spicy meat-a-ball of a product!

Meanwhile, My Favorite CD-ROM Dept.: My all-time CD-ROM favorite is still the 1990 release **Mammals: A Multimedia Encyclopedia**, published by IBM and the National Geographic Society. **Try and find a copy, though.** Few retailers carry it, and getting a copy from IBM is like pulling teeth. IBM's ordering system is hopeless, with few operators even knowing what a CD-ROM is! Call National Geographic (800-368-2728) instead. Containing movies, sound, and **obscure** information, this disk holds the record for

*Overseas readers say
the big U.S. software
companies are forcing
them into piracy. If you
can mail-order from an
Egghead in Idaho
and ship to Bordeaux
for half the local price,
something is wrong.*

keeping my seven-year-old fascinated. Expect to pay \$149 (eeeeek!).

Still Another Use for CD-ROM: A software vendor can reintroduce **dead** products by loading them onto a CD-ROM. Microsoft could sell a CD-ROM full of old versions of Microsoft Word, for example. There are a lot of old machines that simply can't run new software. Old games are perfect for recycling. Hmmmm, how about a CD-ROM full of old Dvorak books and columns?

Gripe of the Month Dept.: If I were to build a computer, I'd engineer the machine so the connectors in the back would be in the front or on the side. I'm sure a lot of neat freaks out there love to bury the mess of wires behind the desk, but

even they must get frustrated when they have to **dig around** to change a modem cable. Front connectors might be too messy, but even reaching around to the side would be better than reaching around to the back, especially on a big floor-standing tower shoved up against the wall. End of tirade #699.

Software Piracy Report: I've been critical of some of the numbers and assertions made about software piracy over the years and have been **criticized** for my thoughts. The writings did manage to trigger plenty of letters from overseas readers who tell me that the big software companies are **forcing them to pirate software** against their will. The argument is that U.S. software sold overseas is **jacked up to outrageous prices** by the software vendors themselves. If the customer tries to buy direct from the States, he or she is told no. Software sold in the U.S. is even marked "Not for Export." This indicates to me that the software companies are behind import restrictions. The marking is to make sure mail-order companies can be **harassed** by import authorities overseas.

Australia's Prices Surveillance Agency has condemned the U.S. software industry and **called for ending import restrictions**. Its says that Australians pay 49 percent more for U.S. software than Americans pay. As far as it's concerned, retailers should **bypass the system** and import directly.

Europeans should also end restrictions on buying direct from the U.S. rather than continue to buy from **money-hungry** distributors established in Europe by U.S. software companies. If you can mail-order from an Egghead in Idaho and ship directly to Bordeaux for half the local price, then something is terribly wrong. I won't even go into the support problems overseas customers have because of the big software makers. □



Exercise Your Video...

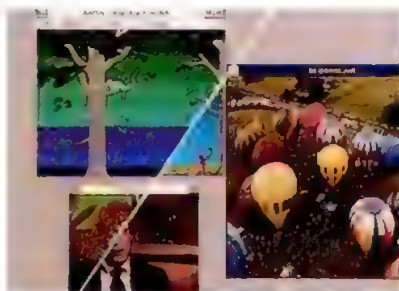
Why settle for an out-of-shape graphics board? Let ATI's new GRAPHICS ULTRA+ and GRAPHICS ULTRA PRO cards pump up your computer with graphics and multimedia video acceleration.

Motion Video Workout

Only ATI's GRAPHICS ULTRA+/PRO cards come ready to accelerate the new generation of multimedia video applications like Video for Windows. Stretch your small video images to partial or full screen for better visibility... and maintain smooth dynamic motion. Other cards experience jerky motion playback, with enlarged video images.



Plus, the GRAPHICS ULTRA+/PRO changes enhanced video image



quality through direct color modes (65,000 colors) and eliminate the color palette conflicts common with 256 colors. ATI protects you from product obsolescence with MVA (Multimedia Video Acceleration) drivers.

accelerated by
mach32
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Build Graphics Muscle

Powered by ATI's *mach32* Accelerator Chip, the GRAPHICS ULTRA cards adds the muscle to run Windows applications fast... even faster than other Local Bus solutions. With 2.0MB of video memory,



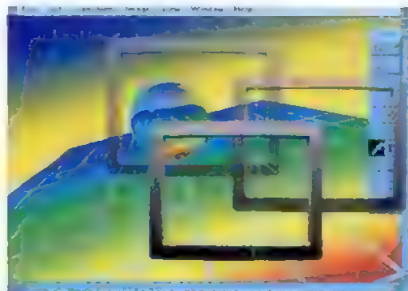


Stretch It!

ATI accelerates 1024x768 resolution in 65,000 colors. Run resolutions up to 1280x1024, colors up to 24-bit, and sit-up to flicker-free graphics at 76Hz refresh rate. Even DOS programs are quicker using zero wait-state VGA operation.

Flex Your Windows

Exercise your options under Windows with the FlexDesk



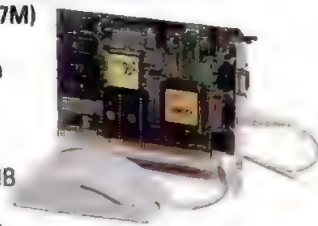
Control Panel... change resolution, color and font display conveniently. ATI's DeskScan allows you to pan and scroll across larger desktops for viewing on small monitors. And our exclusive CRYSTAL FONTS smooths TrueType for laser-quality text right on-screen.

Plus, the GRAPHICS ULTRA+/PRO feature the best software support of ANY accelerator product. Use ATI or 8514/A drivers for high impact acceleration. Run DOS, Windows (3.X/NT), OS/2, UNIX, CAD, and many other applications.

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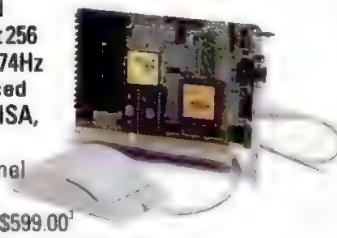
GRAPHICS ULTRA +

- ▶ Accelerated 1024x768 at 65,000 colors
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- ▶ Includes three button input mouse²
- ▶ Available in 1.0MB or 2.0MB versions
- ▶ 5 year warranty
- ▶ Priced from \$399.00³



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- ▶ Even faster performance with VRAMs
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**Multi-platform flexibility.
Multi-project management power.
Unheard-of simplicity.**



As a project manager, you know the problems of managing and coordinating several projects at once: tight schedules, limited resources, different computing platforms.

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Unlike Microsoft, we recognize that today's businesses operate in a multi-platform computing environment. That's why Project Scheduler 5 is the only project management software available in DOS, Macintosh, and OS/2 versions for seamless multi-project management throughout your organization.

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With Project Scheduler 5 you can track resources and status across multiple projects. Integrate multiple projects into groups and establish dependencies that cross project boundaries. Automatically calculate validated group

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A professional product. Backed by professional support.

When you have a question, we'll get you the answer fast—without making you waste your time waiting in an electronic queue. Our support program even provides direct access to Project Scheduler 5's designers. And we offer the most comprehensive training and consulting program in the industry.

The ideal corporate solution.

Whether you're managing multiple projects in a Fortune 500 corporation, or a single project in a small business, Project Scheduler 5 is the fast, easy, and elegant way to make everything come together—on time, every time.

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OOP: Borland's Uphill Battle

Amazing, all the things object-oriented technology can do for software development. You can write and debug code in free-standing modules much faster; you can then draw on the modules in your ever-growing library, combining them to

produce new programs. You can also get out subsequent releases of those programs a lot faster, since you just have to tie in the new or tweaked modules, then recompile.

All true. All coming. Someday.

But so far, the most visible effect of a full-bore commitment to object-oriented development by the company most noisily committed to object technology has been a disaster: Borland's struggles over the past year and a half to get Quattro Pro for Windows and Paradox for Windows out the door. And let's not forget the rewritten dBASE, either.

Borland had a terrible 1992. If Queen Elizabeth thought *she* had had a rough year with Fergie, Andy, Di, Charlie, and a little fire at her country place, she should have considered Borland's year. One of the software business's bright lights dimmed, and one of the industry's most boisterous groups of developers grew quiet as the company's fortunes plunged. Instead of a year of glory and riches triggered by what was supposed to have been one of the hottest-ever new-product-release cycles, Borland's spirit and stock sagged in tandem to all-time lows.

Yes, this was the company that had boasted for so long of its prowess in managing object-oriented development, and of the ultimate superiority of tools for such development. And yes, Borland stayed with that object focus as the company rode Wall Street's down escalator to an ignominious year-end share price in the low 20s.

So, was the problem object-oriented development? Or did Borland just have a bum year?

Everything points toward the latter. By year-end, Borland's Philippe

Kahn was admitting that the company had made many mistakes and that he and his managers had seriously underestimated the time it would take to use object-oriented technology to develop the Windows versions of Quattro Pro and Paradox and to rewrite dBASE.

Actually, that's not quite the whole story: Borland didn't underestimate just the time required to write the new code, but also the time it took to develop the tools with which to write that code. When you start down a revolutionary path in software development, you begin by becoming a tool maker, not a tool user. And almost every time, it takes longer to create the tools than to write the application-program code with those tools.

It is perverse and not at all funny that Borland was brought nearly to its knees using these new techniques for software development; the company has argued with courage, vision, and clarity for the importance of using those same techniques.

ON TO THE 21st CENTURY

Borland was absolutely correct in its insistence on the

importance of leaving behind coding practices that owe more to linear nineteenth-century notions about manufacturing lines than to the late twentieth century's nonlinear embrace of simultaneity and parallel production.

That Borland's stockholders paid a high price for Kahn's vision is a risk of investing in technology: You're bound to get a few arrows in your back.

Oddly enough, I started thinking about this topic one day while discussing the immense problems facing mainframe shops as we move toward the end of the decade. As



Object-oriented programming is the wave of the future. But before we create the apps, we need the tools.

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PC-383

Jim Seymour

you may know, mainframers are in serious denial these days about what will happen a couple of seconds after midnight on December 31, 1999, when many thousands of mainframe programs handling critical business applications discover they don't know how to deal with dates that include the year 2000.

SPAGHETTI CODE

It's not that the world's COBOL programmers don't know how to fix the problem, or that current mainframe programming languages are incapable of handling dates in the next century. The problem is that mountain of old, fragile mainframe code still in use in businesses around the world—often running processes that lie right at the heart of a company's business. These applications have been around so long, were developed in such tangles of spaghetti code, and have been modified in undocumented ways so many times that no one now employed by the company knows how to fix them. In some cases, no one now *alive* knows how to fix them.

That's exactly what the PC business must avoid.

In his Fall Comdex keynote speech, Kahn said, "By the year 2000, we'll be selling you a database manager with 10 million lines of code. And to build a state-of-the-art application that size will take 35 years—if we go on developing software the same old way."

I cannot say that only object-oriented development offers a way out of that mess: Who knows what will come along tomorrow? But for now, it is our best hope of avoiding getting buried under problems and delays far worse than those Aldus, Ashton-Tate, Borland, Lotus, Microsoft, and others have suffered in recent years.

Just as those companies relying on great sloppy bowls of mainframe spaghetti code are in over their heads, so we PC software developers will be in over our heads by the time Version 5.0 or 8.0 of today's product rolls out—and by the time we get those 10-million-line apps Kahn anticipates.

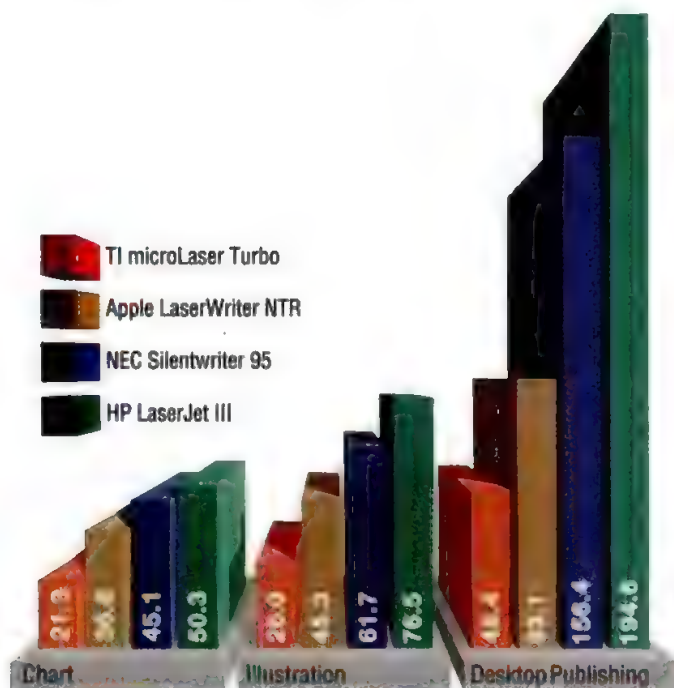
So bear with the software industry as it crawls up a learning slope far steeper than any it has had to climb before. When the tools are right, the apps will flow. And we'll all benefit from bigger and more comprehensive but easier-to-use and much more stable and upgradable applications. □

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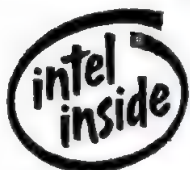
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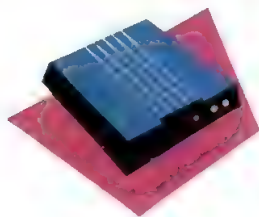
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Bill Howard

Service: Added Value That Counts

The biggest question in looking at PC vendors isn't who gives you the most MIPS or the lowest price: It's who gives you the best service and support. Two of the newest, nicest service-and-support differentiators are the multiyear warranty and

remote diagnostics. Both services started out as a way for some of the smaller mail-order vendors to distinguish their brands. They're now being adopted by the likes of Compaq and IBM. Score two more points for David against Goliath.

The little guys have done the lion's share of the non-technical innovation in the PC industry: mail-order direct sales, free technical support by phone, round-the-clock tech support, on-site service, and the 30-day money-back guarantee. And as the little guys have collectively gained sales, they've forced the major players to add those features to compete.

EXTENDED WARRANTIES

For the longest time, PCs were warranted for one year, parts and labor. But the crankiest parts, the hard and floppy disk drives, have become significantly more reliable. Some hard disks are now rated for 20 years of use before failure. Fewer service calls may occur in the second, third, and fourth years, in part because the system is far beyond the infant mortality stage (a much-exaggerated phenomenon). Also, many first-year service calls occur because the PC, the software, and the user can't mesh properly.

To discover how this affects PC prices, some math is in order. The cost of dispatching a service truck for an on-site visit is roughly \$200. Perhaps 10 percent of all PCs fail each year. To a vendor who has installed, say, 10 PCs at a given site, the service cost per year averages out to \$20 per PC. The vendor can sell you that coverage for \$25 to \$100 per year or add it to the overhead. More vendors are doing the latter.

While many of the Davids of the industry have

been offering two- and three-year warranties for years now, IBM's announcement of a three-year warranty last fall riveted the industry's attention and led to a slew of me-too announcements from some of the other big guys. However, the full extended warranty may apply only to IBM's high-end lines.

REMOTE DIAGNOSTICS

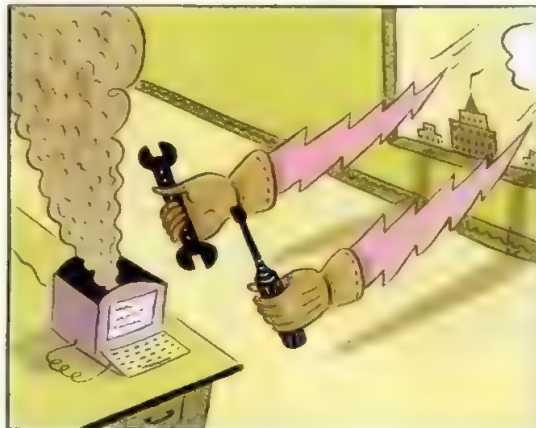
The problems that render a PC unusable may be minor. By including a remote-communications package and a low-cost modem in the system, vendors can quickly examine a balky PC from afar and make minor changes while avoiding the frustrating voice-phone exchanges: "No, type the word T-Y-P-E AUTOEXEC.BAT <Enter>."

When a user has a problem, he or she makes an initial voice call to the vendor. If it's a job for remote diagnostics, the vendor offers to have his computer call the user's computer. If there are two phone lines in the customer's office, the tech support rep maintains the voice call; if not, the remote packages have a chat mode. Technicians can browse files, run remote diagnostics, modify

AUTOEXEC.BAT or CONFIG.SYS, upload patches or drivers, or update a flash BIOS.

If the idea of an outsider roaming through your PC via modem makes you nervous, you can get support the old-fashioned ways: long phone conversations, trial and error, and an on-site service call the next day. By comparison, a 30-minute remote diagnostics call makes sense.

Longer warranties and remote diagnostics are win-win situations for both vendor and user. What the longer warranty costs a vendor may be saved with remote diagnostics. □



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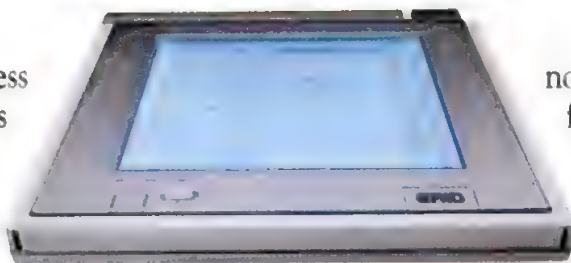
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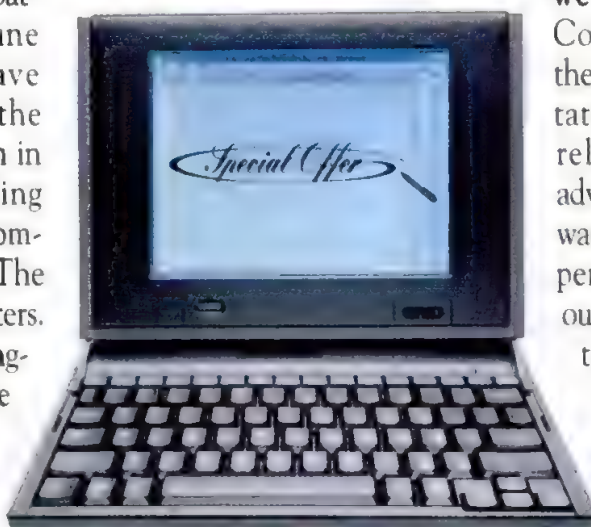
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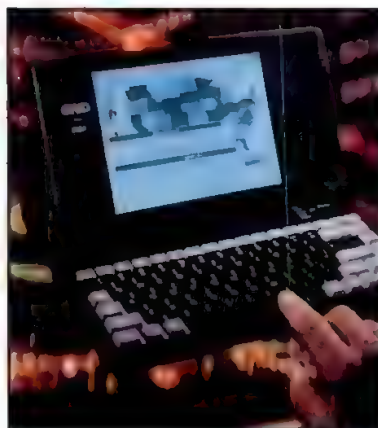
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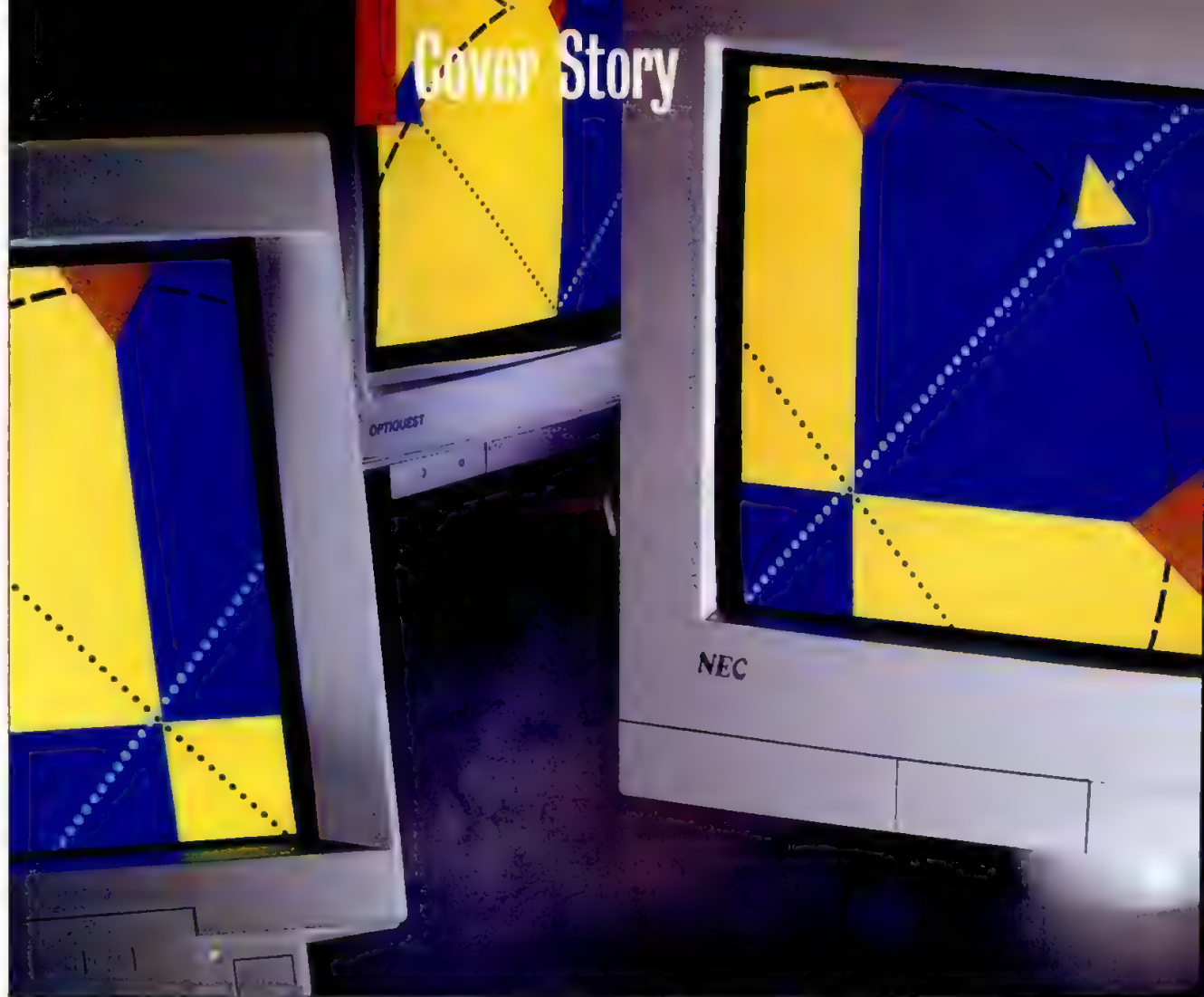
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Your monitor has as much impact on your productivity as does your CPU, hard disk, or graphics adapter. After all, it's hard to get much accomplished when your head aches and your eyes hurt from staring at a screen with a bad case of the shimmy-shakes.

The good news is that equipping your system with a reliable display need not be an expensive proposition. While 16- and 17-inch screens may be the preferred choice for running Windows, their premium prices—usually from \$1,000 to \$1,400 on the street—put them out of reach for many users. A 14- or 15-inch monitor can't supply you with as much screen real estate as a larger counterpart can furnish, but its street price is proportionally lower. In general, you'll pay about \$350 to \$450 on the street for each of the 35 14-inch multifrequency displays we review here and from \$500 to \$600 for each of the 23 15-inch multifrequency designs. (In some cases, you can even find 15-inch units—such as the FORA Addonics C152/LR, the

Hitachi/Nissei SuperScan 15, and the Relisys RE-1558—at 14-inch prices.) Another advantage of 14- and 15-inch screens is that they take up a smaller chunk of your desktop than do their higher-end cousins.

THE MAINSTREAM MONITOR

Today's mainstream choice for the PC is a 14-inch, VGA-only color monitor. But the handwriting is on the wall, or rather, the electron beam is on the screen. Multifrequency monitors that offer VGA, Super VGA (800-by-600), and sometimes 1,024-by-768-or-greater resolutions are quickly taking over. VGA-only monitors of all sizes are said to have outsold 14- and 15-inch multifrequency monitors by two to one (4.6 million compared with 2.3 million) in the U.S. market in 1992, according to the market-research company International Data Corp. But IDC expects that by 1996, sales of VGA-only monitors will fall to 4 million and sales of 14- and 15-inch multifrequency monitors will nearly triple their 1992 numbers—rising to

by M. David Stone

14- and 15-Inch Monitors

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<i>MAG MX15F</i>	150		

almost 7 million units.

And in the 14- versus 15-inch contest, 15-inch screens—just introduced in 1991—are rapidly encroaching upon 14-inch territory. Dataquest, a market-research company based in San Jose, California, says that roughly 15.4 million 14-inch monitors (VGA-only and multifrequency) were sold worldwide in 1992, compared with just a little under 700,000 15-inch monitors. But Dataquest expects sales of 14-inch monitors to drop each year by more than 30 percent over the next four years and sales of 15-inch monitors to rise by more than 80 percent per year in the same time frame. By 1996, Dataquest projects, 15-inch monitors will move far ahead, with about 7.5 million units sold compared with 3.3 million for 14-inch models.

The trend toward multifrequency capability and 15-inch size is easy to understand. The primary reason for both trends is the rise in popularity of graphical user interfaces (GUIs) in general and

of Microsoft Windows in particular.

If you are a GUI user, you will want a multifrequency monitor so that you can work at both VGA resolution in DOS (or for a full-screen DOS Window) and a higher resolution in Windows. As you move to a higher resolution in Windows, you can see more information on-screen at once. Fill an entire VGA screen with Program Manager icons, switch to Super VGA (SVGA), and you'll find you have enough screen real estate to add roughly one-third again as many icons. You'll also find that any given amount of information fits in a window that takes up only about two-thirds of the screen area in SVGA it would take in VGA. This assumes, of course, that you don't make any adjustments in font size. And because the

pixels in each character are more closely spaced together at a higher resolution than they are at a lower resolution, the higher resolution results in smoother characters. Of course, those characters are smaller in SVGA mode than they are in VGA mode for any given size display.

Windows 3.1, many graphics board drivers, and third-party font-scaling software all have provisions for changing the size of the on-screen font. Here's where it helps to have a larger screen. If you stay with the 14-inch screen you've always used for DOS, and then adjust the apparent size of fonts via software to compensate for their shrinking at 800-by-600 or better resolutions, you'll gain smoother characters—but not screen real estate. The same procedure with a 15-inch monitor lets you adjust your fonts in SVGA mode to the same apparent size you're used to in VGA mode on a 14-inch monitor—while still using a smaller percentage of the screen.

SCREEN-SIZE ISSUES

As you can see, screen size becomes increasingly important at higher resolutions. But be aware that the way monitor sizes are classified is a bit misleading: The sizes are given as diagonal measurements, corner to corner, of the cathode-ray tube (CRT) itself, rather than of the glass visible within the monitor's bezel. For the 14-inch monitors covered here, for example, the measured visible diagonal screen size—the glass within the bezel from the bottom left corner diagonally to the top right, including any black borders—ranged from 13.0 to 13.8 inches. This overlaps the measured screen sizes of the 15-inch monitors, which ranged from 13.4 to 14.2 inches.

A measured visible diagonal screen size of up to 14 inches on a typical 15-inch monitor means that you can adjust the image to fill the screen—edge to edge and top to bottom. But measured screen sizes of 13.5 inches or more (on most typical 14-inch monitors) will leave an unacceptably large border of black between

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14- and 15-Inch Monitors

the largest possible image and the bezel—in some cases as much as 1.5 inches total on the left and right side.

As a rule of thumb, a 14-inch monitor is large enough for VGA and adequate for SVGA. A 15-inch monitor is a good choice for SVGA and marginally acceptable for 1,024-by-768 resolution.

THE BASICS

If you're looking for a multifrequency monitor, there are a few important basics to keep in mind. Multifrequency monitors can operate at more than one frequency, or, more precisely, at more than one set of frequencies. The relevant frequencies are for both the horizontal and vertical scan rates, which is why these are also called multiscan monitors.

Monitors draw pictures one horizontal line at a time, going from the top to the bottom. The *horizontal scan rate*—also called the horizontal frequency or horizontal scanning frequency—is a measure of how many horizontal lines it draws per second and is given in kilohertz (kHz). The *vertical scan rate*—also called the vertical frequency, vertical scanning frequency, vertical refresh rate, or simply refresh rate—is a measure of how many full screens the monitor draws per second and is given in hertz (Hz).

Horizontal and vertical frequencies are related to each other. For any given resolution, the longer it takes to write each line on the screen, the longer it will take to write—or refresh—the whole screen. With a slow enough vertical refresh rate, your monitor suffers from screen flicker because the phosphor loses its glow before the CRT's electron gun gets back to the same spot to refresh it. (For more information on monitor technology, see the sidebar "What Makes a Monitor Work.") In an effort to eliminate low refresh rates, the industry group VESA (Video Electronics Standards Association) has established minimum refresh rates for popular resolutions. Current VESA specifications are for a 72-Hz minimum refresh rate in VGA and SVGA and 70-Hz at 1,024-by-768.

Fixed-frequency multiscanning monitors will sync with signals from a video card only at specific frequencies within

the monitor's range—at, for example, 56 Hz, 60 Hz, 70 Hz, and 72 Hz. Variable-frequency multiscanning monitors will sync anywhere within a continuous range—from, for example, 50 Hz to 90 Hz. Fixed-frequency monitors will become less flexible if new combinations of vertical and horizontal frequencies be-

Screen size becomes increasingly important at higher resolutions. But beware: The way monitor sizes are classified can be misleading.

come popular—if, for example, VESA recommends higher minimum refresh rates in the future. With a 14- or 15-inch monitor, however, such flexibility is less important than it is with larger monitors; most users won't run them beyond 800-by-600 mode, and the current VESA standard for SVGA is enough to eliminate flicker under nearly any conditions.

One last issue is the importance of digital controls. With multifrequency monitors, image size and position can be a problem, since they will tend to change

with different modes and frequencies. The easiest way to solve this problem is to add a digital memory to the monitor and digital controls for changing the various settings. You can then save the settings for each set of frequencies you normally use and let the monitor automatically load the appropriate settings for each mode. By our count, 9 of the 23 15-inch monitors in this review provide digital memory and controls, but this feature is less common on 14-inch monitors; only 5 of the 35 in this review include them.

PERFORMANCE TEST RESULTS

Our tests of these monitors included objective measurements of luminance, horizontal and vertical pincushioning, maximum horizontal and vertical misconvergence, and average modulation transfer function (MTF). For these tests, we used the Microvision Superspot 100 and the Minolta Color Analyzer CA-100. In addition, we used Sonera Technologies' DisplayMate Professional software as part of our subjective evaluations. The

HIGHLIGHTS

14- and 15-Inch Monitors

THE 58 14- and 15-inch multifrequency monitors we tested for this issue cost from about \$350 to \$600 on the street. In general, a 14-inch monitor is large enough for VGA and adequate for Super VGA; a 15-inch monitor is a good choice for SVGA but only marginally acceptable for 1,024-by-768.

ACTUAL visible diagonal screen sizes (from bezel to bezel) for these 14-inch monitors ranged from 13.0 to 13.8 inches; the 15-inch units measured from 13.4 to 14.2 inches.

ON THE AVERAGE MODULATION Transfer Function (MTF) test, which measures a monitor's sharpness, both the Compaq QVision 150 and the NEC MultiSync 3FGX monitors excelled.

DIGITAL controls allow you to save specific settings for the different image sizes and positions that result from changing modes and frequencies. Nine of the 23 15-inch monitors we tested here provide digital memory and controls, whereas only 5 of the 35 14-inch monitors include them.

ALL BUT THREE of the 14-inch monitors we reviewed for this roundup use standard, spherical section tubes with a 0.28-mm dot pitch. The three exceptions are the MAG InnoVision MX14S, the Sony CPD-1304S, and the Seiko CM1450, which all use 0.25-mm grill pitch Sony Trinitron tubes. In contrast, most of the 15-inch monitors are built around flat square tubes; the Compaq QVision 150, with its 0.26-mm Zenith Flat Tension Mask tube, is the one exception.



EDITORS' CHOICE

DisplayMate utilities can test features such as aspect ratio, blossoming (image sharpness), misconvergence, screen disturbance when switching between text and graphics modes, and screen regulation. In addition, we ran several Windows programs, loading a string of tightly packed text to see if images would lose crispness.

Keep in mind that in many ways, the subjective tests are more relevant because the Superspot is sensitive enough to pick up the slight flaws that the naked eye can't see or that aren't bothersome even if it can. And remember that no two monitors—even a pair of the same models from the same vendor—are exactly alike. Use our results as an indication of relative performance.

On the Luminance test, which measures maximum usable screen brightness at maximum focus, a score of 15 foot-lamberts (fl) is generally the minimum acceptable. Any score higher than that is not necessarily better in terms of visual display; it simply implies that there is a greater range to fall back on over the life of the monitor. As the monitor loses brightness with age, you can still crank up the brightness to acceptable levels. At VGA resolution, all the monitors scored above 15 fl. Increasing resolution, however, can yield a dimmer image. In SVGA mode, two monitors scored a little below the 15-fl threshold: the IOcomm Think-Sync 5, at 14.0 fl, and the ADI MicroScan 4A, at 14.1 fl. Other units, however, showed little or no drop-off, and some even had higher brightness scores in SVGA mode than in VGA mode.

Vertical pincushioning is more obvious than horizontal pincushioning, making it a more important measure of a monitor's performance. In VGA mode, three monitors had large Vertical Pincushioning scores of 1.0 mm or above, a significant departure from the optimal measurement of 0.5 mm or less. The Aamazing CM1528FS was the most extreme, at 1.377 mm. In SVGA mode, none of the monitors were off by 1.0 mm. Note that a standard, spherical screen or a curved bezel can affect your perception of a nearby line, giving or hiding the illusion of pincushioning, and this means that perceived pincushioning can differ markedly from a measured result. Note

- **14-inch:** ADI MicroScan 3E+
Optiquet 1500D
- **15-inch:** MAG MX15F
Nanao Flexscan F340iW
NEC MultiSync 4FG

Whether you're simply looking for a decent picture at a low price or a higher-quality display with outstanding screen values, you'll find what you want in this group of 58 14- and 15-inch monitors.

By and large, most of the monitors provide accep-

table performance. Editors' Choices go to two 14-inch units that distinguish themselves with extras such as digital controls and three 15-inch models that are hard to surpass in display quality and feature set.

The ADI MicroScan 3E+ and the Optiquet 1500D are alike in almost every way, from their spherical tubes to their 13.5-inch visible diagonal screens to their maximum noninterlaced resolutions of 1,024-by-768 at 72 Hz. Their smooth digital controls include all the basics and more, thanks to an easily accessible dual in-line package (DIP) switch that allows you to temporarily change them to servicemen controls, which adjust for advanced features such as pincushioning and trapezoidal distortion. Another plus is that saving up to 10 settings is easy; the pincushion controls take the sting out of the slightly high Horizontal Pincushioning test results, and in real-world applications, none of its minimal misconvergence problems were objectionable.

The main differences between the MicroScan 3E+ and the Optiquet 1500D are in price and warranty. ADI Systems offers a \$749 list price and a two-year warranty; Optiquet offers a \$499 list price and one-year warranty. On the street, though, the difference shrinks to \$35 to \$65, with the 3E+ selling for around \$450 and the 1500D going for about \$385 to \$415.

If you're looking for a top-of-the-line 14-inch display, make your choice

between these two on the basis of your budget and service needs.

15-INCH CHOICES

In the 15-inch monitor marketplace, the \$899 MAG MX15F stands out for its combination of easily accessible front-panel digital controls with 17 memory settings, mode-based auto-sensing, a highly ergonomic 76-Hz refresh rate in Super VGA and 1,024-by-768 noninterlaced modes, and a generous visible diagonal screen size of 13.8 inches. It also boasts a flat square tube (FST) with an Invar shadow mask. Neither the pincushioning nor the misconvergence reported by the Superspot was visible to the naked eye. With a \$600 street price, the MX15F is still more expensive than much of its 15-inch competition, but it costs only a fraction more than its 14-inch sibling, the MX14S, which can be found for about \$550. The MX15F's larger, sharp display is well worth the extra \$50.

The \$899 Nanao Flexscan F340iW—about \$725 on the street—is a pricey entry, but worth the money. It has an FST, the ability to store up to 28 settings, and digital controls with choices for pincushioning, trapezoidal distortion, and color matching. Moreover, it boasts refresh rates of 76 Hz in noninterlaced 1,024-by-768 mode and 90 Hz in noninterlaced 800-by-600 mode. This unit has one of the sharpest, steadiest screens we saw and a 13.8-inch bezel-to-bezel measurement

14- and 15-Inch Monitors

that is anything but stingy. Choose this one if your budget is flexible and your taste high class.

Finally, NEC continues its standard of excellence with the MultiSync 4FG. The \$759 ticket reflects NEC's new policy that substitutes "estimated street prices" for list prices, so any discounts will be small. The MultiSync 4FG boasts an FST with an Invar shadow mask, a 13.8-inch visible screen, a maximum noninterlaced 1,024-by-768 resolution at 70 Hz, mode-based autosensing, an array of digital controls (which includes color-matching and pincushioning controls), and a display notable for its unimpeachable sharpness and color alignment. But the unit sacrifices built-in antiglare measures in favor of an ultra-bright screen. Consider NEC's optional \$69 standard and dark antiglare lenses to combat this, although you will lose some brightness in the process.

OTHER OPTIONS

Other products in this review are also worthy of mention. If you're on a tight budget but want a 15-inch model, consider the Hitachi/Nissei SuperScan 15. Despite a high \$795 list price, it is sold by dealers for \$420—about the cost of some 14-inch units. It lacks digital controls but supports mode-based auto-sizing and has one of the subjectively brighter screens of this group. This monitor performs best in SVGA or VGA modes.

The \$793 Compaq QVision 150's best features include BNC connections, digital controls, and a 0.26-mm dot pitch. But it doesn't settle quickly when switching between text and graphics modes. And at \$660 on the street, it's a little more costly than units such as the MAG MX15F.

Finally, the Sony CPD-1304S is a solid performer, with its Trinitron tube and 0.25-mm aperture grill pitch. But you pay a high price—\$1,029.95 list and \$580 on the street—for a 14-inch analog display.

that ZD Labs used the default setting in determining Vertical and Horizontal Pincushioning test scores, but 21 monitors—including the MAG LX1460, Nanao Flexscan F340iW, NEC MultiSync 3FGX, and NEC MultiSync 4FG—include pincushion controls. Remember that those that generated unsatisfactory results here can often be adjusted to provide a better image.

On the Misconvergence tests, measurements greater than one half of a line width—about 0.25 mm—are generally enough to cause visible blooming, but results up to about 0.4 mm are still acceptable for most users. The monitor with the most serious convergence problem at 640-by-480 was the Relisys RE-1458, with a score of 0.640

mm on the Maximum Vertical Misconvergence test. Its sibling, the Relisys RE-1558, provided the poorest Maximum Horizontal Misconvergence score in 800-by-600 mode: 0.518 mm. Note that monitors with etched screens—more than half of the units in this review, including the offerings from IBM and MAG InnoVision—will diffuse the image, minimizing the perception of any misconvergence.

On the Average Modulation Transfer Function test, which measures a monitor's sharpness, two units excelled in VGA mode, scoring significantly higher than the minimum recommended 50 percent: the NEC MultiSync 3FGX, at 73.5 percent, and the Compaq QVision 150 Color Monitor, at 71.0. At higher resolutions, most monitors will lose some focus, and both followed this general rule. Even so, their respective scores of 68.5 percent and 64 percent in SVGA mode still bested the scores of the competition.

REVIEW CRITERIA

For this review, we looked at both fixed- and variable-frequency multiscanning 14- and 15-inch monitors capable of an SVGA resolution at a minimum of 72 Hz. In all, we found 35 14-inch and 23 15-inch

monitors that fit the filter. Three units sent for testing were not included here because they did not support a 72 Hz refresh rate at 800-by-600: Hewlett-Packard's \$599 Ergonomic Super VGA Display, Panasonic Communications and Systems Co.'s \$699 PanaSync 1381i, and Zenith Data Systems' \$399 ZDS ZCM-1430. The following products were not

supplied in time for testing: In the 14-inch arena, they were Goldstar Technologies' \$849 1490, \$699 1465, and \$599 1460 SVGA; First International Computer's \$235 LEO 1405; Hyundai Electronics America's \$319 HCM-423E and \$379 HCM-433E; Idek/Iiyama North America's \$495 DR-3114; and Proton's \$699 CM1430. In the 15-inch market, they

were Goldstar's \$799 1510, Everex's \$879 Pro 15, Idek/Iiyama's \$765 MF-5315, and Intra Electronics' \$700 CM1501. New units from Samsung and Sceptre were still in the prototype stage at test time.

Several trends turned up in this group. For example, except for MAG InnoVision's MAG MX14S, the Sony CPD-1304S, and the Seiko CM1450, which use Sony Trinitron tubes, all the 14-inch monitors in this roundup use standard, spherical section tubes. In contrast, all but one of the 15-inch monitors are built around a flat square tube—a design that isn't truly flat or square but gives the illusion of flatness. The exception in 15-inch monitors is the Compaq QVision 150, which uses a Zenith Flat Tension Mask tube. This truly flat design produces high-quality images but paradoxically gives the illusion of being slightly concave.

You'll also find that a 0.28-mm dot pitch (or aperture grill pitch, as it is called for Trinitron designs) is standard among these units; only the Compaq QVision 150—with its 0.26-mm dot pitch—and the MAG MX14S, Seiko CM1450, and Sony CPD-1304S—with tighter aperture grill pitches of 0.25 mm—depart from this trend. About half of the 15-inch monitors

*Two units excelled on
our Modulation
Transfer Function test,
which measures a
monitor's sharpness: the
Compaq QVision 150
and the NEC
MultiSync 3FGX.*

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and none of the 14-inch monitors use shadow masks made of Invar, a metal alloy that does not expand much when heated and consequently maintains a more constant set of characteristics.

Fewer monitors than you might expect support the MPR Level I or Level II Swedish emission standards as part of their base packages; 5 monitors support MPR Level I only, 19 units support MPR Level II, and 6 units offer MPR Level II support only as an extra-cost option. The MPR Level I standard relates to the electrical component of very low-frequency (VLF) emissions, and the Level II standard covers the levels of magnetic and electrical fields of both VLF and extremely low-frequency (ELF) ranges.

One last trend worth mentioning is a recognition by vendors that list prices are potentially misleading. NEC Technologies and Packard Bell Electronics, for instance, now quote "estimated sales prices" and "estimated street prices," respectively, for their units. For the comparison shopper, this is a welcome development indeed. And with industry leader NEC taking this approach, we can hope that a lot more companies will follow suit.

You'll find the reviews grouped in alphabetical order by company name. When two or more monitors from different vendors are identical to each other, we placed them in the same review, using the vendor's name that comes first alphabetically to determine the location of the review in the magazine. If a single vendor sent two or more monitors for testing, you will find both those monitors in the same review; an exception may be if a unit is identical to other vendors' models, in which case it is grouped with those similar systems.

Aamazing Technologies

Aamazing CM8428MX

Aamazing CM1528FS

BY BRUCE BROWN

The \$499 14-inch Aamazing CM8428MX and the \$699 15-inch Aamazing CM1528FS from Aamazing Technologies are both variable-frequency analog monitors with aggressively low street prices.



AAMAZING CM8428MX

For an attractive \$329 street price, the CM8428MX offers satisfactory performance. Equipped with a conventional shadow-mask spherical tube, this monitor has a visible display area of 13.2 inches. The unit's top noninterlaced resolution is 1,024-by-768 at a 60-Hz vertical refresh rate.

As with the CM1528FS, the CM8428MX has a 0.28-mm dot pitch and the basic analog controls. And like the 15-inch unit, the CM8428MX has dark-tinted glass to control glare, though you can still see your reflection.

The CM8428MX passed Superspot testing without significant problems, though Maximum Horizontal Misconvergence test results in VGA were just a little high (0.364 mm). Subjective tests went smoothly: We saw minimal muddiness between tight text, minor moire patterning, not much bounce on mode switching, and good regulation. But you will have to readjust the image size when you switch between modes.

The CM8428MX is certainly worth its price for low-budget users on Windows or DOS systems.

AAMAZING CM1528FS

The 15-inch Aamazing CM1528FS is a solid monitor with an enticing street price of \$479. The unit provides a 13.6-inch diagonal viewing area; the provided adapter cable has miniDB-15 connections on both ends.

The CM1528FS flat square display supports up to 1,280-by-1,024 noninterlaced resolution and runs at a 72-Hz vertical refresh rate in that mode and at 74 Hz in lower modes. It also claims infinite autosizing, though in practice some ad-

justment was needed.

On Superspot tests, the CM1528FS turned in the highest Vertical Pincushioning test result in 640-by-480 mode (1.377 mm). But it scored respectably on this test in Super VGA mode (0.254 mm) and had the best score for SVGA Maximum Vertical

Misconvergence (0.150 mm). The unit fared well in subjective testing; we didn't see any serious pincushioning but did notice quite a bit of moire patterning.

Overall, the Aamazing CM1528FS is a decent offering, especially with its ability to run noninterlaced VGA, SVGA, and 1,024-by-768 resolutions at a flicker-free 74 Hz.

Acer America Corp.

AcerView 56L

FORA Inc.

FORA Addonics C152/LR

Optiquet Inc.

Optiquet 2000DX

ViewSonic

ViewSonic 6FS

BY M. DAVID STONE

"Four of a kind" sounds like a poker hand, but in this case it refers to four 15-inch digital monitors: the \$899 AcerView 56L, the \$599 FORA Addonics C152/LR, the \$649 Optiquet 2000DX, and the \$699 ViewSonic 6FS. They share an identical FCC identification number (registered to Acer America) and are otherwise essentially identical. Any one of them qualifies as a better-than-average choice.

These units don't have as wide a spread in street prices as they do in list prices. The FORA Addonics C152/LR's low list price translates to the best bargain on the street as well (about \$459), while prices of the AcerView 56L and ViewSonic 6FS both come down to approximately \$560. The Optiquet 2000DX is typically discounted to a price

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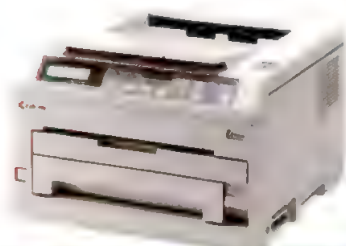


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14- and 15-Inch Monitors



The AcerView 58L, FORA Addonics C152/LR, Optique 2000DX, and ViewSonic 6FS

ranging from \$560 to \$575.

Basic features on each include a 0.28-mm dot pitch, variable-frequency scanning, a maximum resolution of 1,024-by-768 noninterlaced at 72 Hz, a tilt/swivel stand, a permanently attached adapter cable, and an etched screen that aids in fighting glare. The flat square tube with an Invar shadow mask is very much a plus. The visible diagonal screen size for all the monitors is 13.5 inches.

The digital memory can hold 32 mode settings and comes with 16 preset. The all-digital controls are conveniently placed just below the screen. Brightness and contrast have their own control buttons while the rest, including a pincushion control, are combined into a set. You use a select button to cycle through the choices of functions, as shown by status lights, then an adjustment control to change the setting. Saving is automatic.

On the Superspot tests in VGA and Super VGA modes, the Acer and FORA monitors had slightly poorer Maximum Vertical Misconvergence scores than the other two units managed, and Optique's system had a less-impressive showing on the Maximum Horizontal Misconvergence test in both resolutions.

But in subjective testing, blooming was not noticeable. The Optique 2000DX's Vertical Pincushioning results were also not among the best, but you can use the pincushion control to eliminate any bowing. No other results on the subjective tests were aberrant.

ViewSonic and Optique sell other 15-inch monitors: The \$649 Optique 2000D is covered elsewhere in this story, while the newly announced \$849 ViewSonic 15 wasn't shipping at test time. The ViewSonic 15 will offer a maximum non-

interlaced resolution of 1,280-by-1,024 and include color temperature controls.

Although none of these monitors provide a display on equal footing with a unit such as the Nanao Flexscan F340iW, for example, their 15-inch flat square tubes, digital memories, and good prices make any one of them a more-than-acceptable choice for Windows users. These are products worth considering.

ADI Systems Inc.

ADI MicroScan 3E

ADI MicroScan 3E+

ADI MicroScan 4A

Compaq Computer Corp.

Compaq 1024 Color Monitor

Optique Inc.

Optique 1500D

Optique 2000D

BY M. DAVID STONE

At a casual glance, these six monitors—ADI Systems' MicroScan 3E, 3E+, and 4A; the Compaq 1024 Color Monitor; and the Optique 1500D and 2000D—look identical, right down to their digital controls. A closer look shows that there are actually four models; the group of six includes two pairs of apparently identical twins. All are solid if not outstanding performers, though not all are without flaws.

Among them is a pair of 15-inch monitors, the \$859 MicroScan 4A (with a street price of about \$520) and the \$649 Optique 2000D (with a street price ranging from \$570 to \$645). These closely

related monitors share the same FCC identification number, registered to ADI, and are also the only ones with flat square tubes. The second paired set also sports identical FCC numbers, again registered to ADI, and consists of the \$749 MicroScan 3E+ (about \$450 on the street) and the \$499 Optique 1500D (with a street price ranging from \$385 to \$415). These two, as well as the \$441 Compaq 1024 and the \$649 MicroScan 3E (which you can find for about \$365 and \$400, respectively), use 14-inch spherical section tubes. The folks at Compaq Computer Corp. say the 1024 is custom-built by ADI; it differs in mostly minor ways from the MicroScan 3E+.

SOME THINGS IN COMMON

The monitors all offer a 0.28-mm dot pitch and a maximum noninterlaced resolution of 1,024-by-768 at a vertical refresh rate of 60 Hz for the 3E and 72 Hz for the others. The maximum interlaced resolution for each unit is 1,280-by-1,024, according to ADI, although Compaq claims a conservative 1,024-by-768.

Other shared features include an anti-static coating and an etched screen that keeps glare to an unobtrusive level. Most can store up to 10 settings simultaneously: The MicroScan 3E is the exception, storing a total of 9 settings.

Controls are conveniently located in front, below the screen. Except for brightness and contrast, all are digital. All are comfortably smooth and precise, with changes made to settings automatically stored. The buttons are clearly marked with basic functions, but a flip of an easily accessible dual in-line package (DIP) switch lets you temporarily change them to servicemen controls. These controls include two that let you adjust pincushioning. A third lets you control trapezoidal distortion.

On the Superspot tests, some of the Pincushioning test results were a bit high, but the presence of pincushion controls means that you should be able to resolve any problems. In VGA mode, just about all the units had scores that were a little higher than desirable on both Misconvergence tests. The exceptions were the MicroScan 3E and 3E+ and the Optique 2000D, which performed well within an acceptable range on the Maxi-

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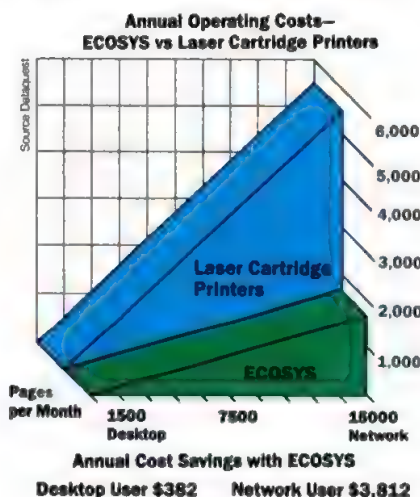
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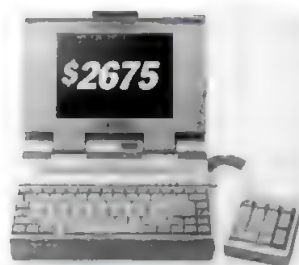
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Color 486 DX-33 MHz
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■ What Makes a Monitor Work?

by Michael J. Zulich

A monitor may look like a fairly simple device—nothing more than a CRT—but don't be fooled. Today's color Super VGA monitors are complex components.

For starters, the inner face is coated with thousands of phosphor dots. Rated by persistence—the duration the dots glow before fading to invisibility—phosphors are categorized as short, medium-short, medium, medium-long, and long.

Older monochrome monitors used medium-long-persistence phosphors, which glowed long after the electron beam ceased to emit. Changing a screen image (scrolling through a document, for example) would leave a ghost of the previous image on-screen. Color SVGA monitors (like those reviewed here) typically use medium-short-persistence phosphors, enabling faster image changes and eliminating ghosts.

In the back of the monitor is the electron gun, which fires electrons at the coated inner surface, striking the phosphors and causing them to glow. A CRT is essentially a vacuum tube with a cathode (electron gun) and anode (phosphor-coated screen) that allow electrons to fly freely from negative to positive.

The monitor's yoke, a magnetic coil, deflects the electron emission into a stream.

Monochrome monitors use one electron gun and single phosphors, but most color monitors use three electron guns and colored phosphors arranged into triads. One gun is aimed at the red phos-

phor, one at the green, and one at the blue. The beams are turned on and off to produce different colors. In-line-gun color monitors have electron guns and phosphors aligned axially in a vertical line, allowing for more precise aim.

To paint a screen image, the electron gun traces a path from the upper left-hand corner to the lower right-hand corner. This action repeats anywhere from 43 to 87 times per second, depending on phosphor persistence and the scanning mode employed—interlaced or noninterlaced. The speed of the action, measured in Hz, is called the *refresh rate* or *vertical scan rate*. Longer-persistence phosphors require a lower refresh rate than shorter-persistence phosphors. The monitors we tested support the Video Electronics Standards Association (VESA) standard vertical refresh rate of 72 Hz noninterlaced at 800-by-600.

To help the guns focus on these glowing phosphors, each monitor has a mask on the inner surface of the tube between the phosphor coating and the electron gun. A metallic foil pierced with tiny holes, the mask is made from heat-resistant, nonmagnetic alloys. Its purpose is to prevent stray electrons from lighting phosphors adjacent to the

intended phosphors. The mask takes an electron beating and eventually suffers from heat fatigue, which can lead to a loss of focus. Innovations in mask design have led to improvements in the material used. Invar, an alloy with greater heat resistance than the standard mask material, helps monitors maintain sharp focus as they age.

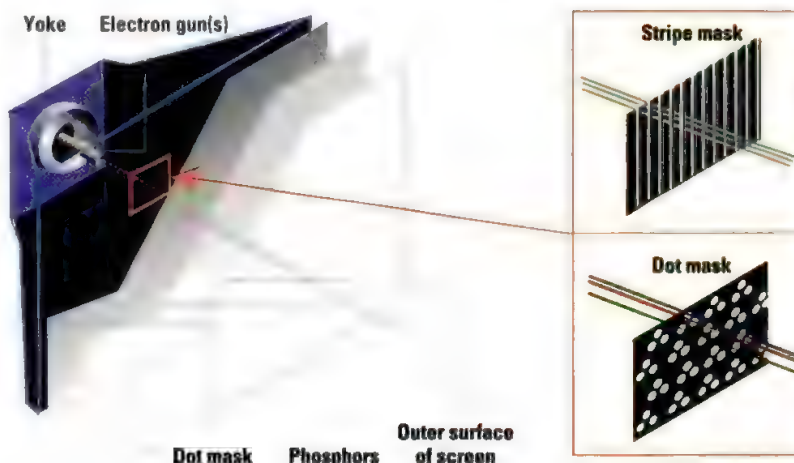
The most common mask design used in SVGA monitors is the dot mask, or shadow mask, so named because of the tiny, round (dot-shaped) holes. Trinitron monitors use stripe masks resembling elongated rectangles formed by wires held in a vertical pattern, which allow them to form crisper lines. These wires are also a little less prone to heat fatigue.

The electron beam passes through the perforation to illuminate the pixels. Each *pixel*, the smallest dot of light that a monitor can produce, is a triad of red, green, and blue phosphors. It is also the standard unit of measure for screen resolution, such as SVGA's 800-by-600. The *dot pitch*, or distance between two like-colored phosphors in adjacent triads, is akin to pixel size. Lower dot pitch and greater resolution yield a crisper display image. Typical dot pitches measure from 0.24 mm to 0.51

mm; monitors here have dot pitches of 0.25 mm to 0.28 mm.

As monitor technology improves, screen resolutions will increase and dot pitches decrease. Advances in mask materials and improvements in electron-gun design will produce monitors of ever-increasing clarity. □

What's Behind the Image



Most of the monitors in this review managed acceptable performance on the majority of these tests. Among the top performers on the sharpness test were the NEC MultiSync 3FGX and the Compaq QVision 150 Color Monitor in both VGA and Super VGA modes. In VGA mode, the Sampo AlphaScan 15 had the best brightness score, but the Nanao Flexscan F340iW took the lead there in SVGA mode.

In interpreting the test scores, bear in mind that misconvergence will be less obvious on monitors with etched screens, and pincushioning problems can sometimes be minimized using a monitor's controls.

How We Tested

For this roundup of monitors, ZD Labs used the Microvision Superspot 100 to test the 14- and 15-inch monitors. This device calculates spatial relationships and uses a tiny array of photodiodes to measure the light emitted from the screen.

Using ATI Technologies' VESA-compliant Graphics Ultra Plus graphics adapter, we drew a series of horizontal and vertical lines for testing in resolutions of 640 by 480 pixels (for the 14- and 15-inch monitors) and 800 by 600 pixels (for the 15-inch monitors). The SuperSpot 100 used those lines to measure screen anomalies and image problems in the monitors, such as pincushioning and misconvergence. For testing at both resolutions, we configured the graphics adapter for a 72-Hz vertical refresh rate (which is the VESA standard for 640-by-480 and 800-by-600 operation). We also used a Minolta Color Analyzer CA-100 in our testing to measure the maximum usable brightness.

Please remember that monitor performance varies among units from the same manufacturer and can even vary within the same model. This explains the differences that you may notice among the scores of identical units produced by different manufacturers. Our tests are an indication of a monitor's relative performance; they do not characterize the absolute attributes of any one display.

The **Average Modulation Transfer Function (MTF)** is an indicator of a monitor's sharpness. We measure the relative brightness of white and black pixels within two series of 1-pixel-wide horizontal lines (spaced a pixel apart), and again within similar series of vertical lines. Meanwhile, we adjust the monitor intensity controls until we are able to obtain optimal contrast. Using this setting, we take the average result from two horizontal and two vertical tests and calculate the MTF as a ratio of contrast to maximum usable intensity. A score of 50 percent or greater is good.

640-BY-480 RESOLUTION

	Average MTF (percent)*	Luminance (fL)**	Maximum Vertical Misconvergence (mm)†
Aamazing CM8428MX	55	27.2	0.262
Aamazing CM1528FS	67	25.0	0.175
AcerView 56L	62	16.6	0.386
ADI MicroScan 3E	65	21.3	0.433
ADI MicroScan 3E+	60	26.2	0.297
ADI MicroScan 4A	63	16.1	0.271
AOC CMLB-337	58	20.3	0.236
AOC CM-536	60	20.3	0.496
Arche 214MH VGA Monitor	58	24.8	0.194
Compaq 1024 Color Monitor	54	20.0	0.419
Compaq QVision 150 Color Monitor	71	28.9	0.343
CTX CMS-1461	60	29.0	0.223
Darius HRN-1424	57	34.6	0.248
Dell UltraScan 14C	53	25.2	0.149
Dell UltraScan 14LR	66	30.4	0.273
Dell UltraScan 15FS	58	26.3	0.229
Dell UltraScan 15LR	54	31.7	0.187
FORA Addonics C141	57	31.1	0.302
FORA Addonics C143	54	23.0	0.352
FORA Addonics C152/LR	54	20.9	0.338
Hitachi/Nissei SuperScan 15	63	22.2	0.167
IBM PS/ValuePoint 6312 Color Display	57	19.6	0.214
IBM PS/ValuePoint 6314 Color Display	55	20.2	0.401
IBM PS/ValuePoint 6319 Color Display	53	22.8	0.373
IOcomm ThinkSync 4E	60	33.7	0.240
IOcomm ThinkSync 5	64	20.0	0.133
MAG LX1460	56	31.0	0.132
MAG MX14S	63	33.1	0.172
MAG MX15F	65	23.6	0.443
Mitsuba 710VX	61	20.7	0.146
Mitsubishi Diamond Pro 14 Color Monitor	65	30.6	0.353
Nanao Flexscan F340iW	66	33.0	0.131
NEC MultiSync 3FGX	73	18.9	0.495
NEC MultiSync 4FG	56	31.6	0.325
Neotec NT-1456	55	21.2	0.290
Optquest 1000S	53	22.8	0.256
Optquest 1500D	62	25.3	0.416
Optquest 2000D	59	17.3	0.402
Optquest 2000DX	57	29.1	0.272
Packard Bell PB8548SVGL	61	21.9	0.208
Philips Magnavox MagnaScan/14 Model CM9214	54	35.0	0.242
Qume QM857	58	27.1	0.413
Relisys RE-1458	56	23.9	0.640
Relisys RE-1558	61	26.0	0.338
Sampo AlphaScan Plus	67	23.5	0.225
Sampo AlphaScan 15	59	36.8	0.168
Samtron SC-428TX	62	21.4	0.218
Seiko CM1450	64	26.1	0.326
Sony CPD-1304S	63	27.5	0.246
Sunshine CM8+	59	22.9	0.245
Sunshine CM15C	65	24.7	0.436
Taxan MultiVision 550	63	25.9	0.225
TVM MediaScan 4A+	57	23.3	0.110
TVM LowRadiation 5A+	62	18.2	0.192
ViewSonic 5E	57	25.6	0.323
ViewSonic 6	53	18	0.318
ViewSonic 6FS	61	20.2	0.313
WEN JK1466 Color Monitor	59	25.1	0.389

800-BY-600 RESOLUTION

Maximum Horizontal Misconvergence (mm)†	Vertical Pincushioning (mm)†	Horizontal Pincushioning (mm)†
0.364	0.406	0.262
0.141	1.377	0.305
0.287	0.429	0.396
0.184	0.361	0.615
0.168	0.216	0.594
0.448	0.691	0.787
0.334	0.904	0.254
0.193	0.996	0.584
0.193	0.389	0.351
0.299	0.749	0.673
0.325	0.330	0.437
0.395	0.500	0.269
0.315	0.396	0.389
0.135	0.711	0.559
0.110	0.394	0.940
0.219	0.521	0.279
0.252	0.188	0.180
0.121	0.137	0.470
0.363	0.406	0.541
0.279	0.218	0.373
0.160	0.391	0.391
0.175	0.262	0.267
0.307	0.136	0.927
0.266	0.272	0.147
0.210	0.544	0.318
0.239	0.363	0.381
0.351	0.429	0.495
0.179	0.884	0.419
0.440	0.986	0.340
0.147	0.323	0.544
0.198	1.046	0.472
0.222	0.973	0.394
0.309	0.417	0.203
0.117	0.437	0.274
0.480	0.325	0.528
0.197	0.495	0.564
0.310	0.737	0.645
0.158	0.267	0.488
0.398	0.653	0.198
0.174	1.049	0.155
0.262	0.351	0.267
0.409	0.516	0.373
0.272	0.386	0.457
0.431	0.696	0.737
0.159	0.203	0.274
0.251	0.195	0.673
0.319	0.141	0.122
0.251	0.371	0.242
0.114	0.279	0.157
0.212	0.904	0.391
0.212	0.343	0.742
0.313	0.635	0.351
0.187	0.592	0.592
0.172	0.853	0.345
0.295	0.165	0.544
0.208	0.772	0.277
0.318	0.325	0.528
0.368	0.958	0.254

The **Luminance** test measures the maximum usable screen brightness, which is determined after the monitor's MTF reading is taken. A score of 15 foot-lamberts (fL) or greater is good.

The **Maximum Vertical Misconvergence** test score represents the worst-case convergence of the three electron guns vertically. We measure the distances between the centers of excited red, green, and blue dots within three vertical lines spaced across the screen. We take measurements in the upper-left, upper-right, and lower-right corners and the middle of the screen. We report the largest of the distances. A smaller number indicates that the monitor displays less color "blooming."

The **Maximum Horizontal Misconvergence** test score represents the worst-case convergence of the three electron guns horizontally. The procedure is the same as for the Maximum Vertical Misconvergence test, except that we measure the distance between dots within horizontal lines.

The **Vertical Pincushioning** test measures the curvature of two vertical lines—one in the middle of the screen and one on the right-hand side of the display. Pincushioning is given in terms of the maximum deviation from a straight vertical line. A smaller number indicates a straighter line.

The **Horizontal Pincushioning** test measures the curvature of two horizontal lines—one in the middle of the screen and one at the top of the display. The procedure is essentially the same as for the Vertical Pincushioning test.

800-BY-600 RESOLUTION

	Average MTF (percent)*	Luminance (fL)**	Maximum Vertical Misconvergence (mm)†	Maximum Horizontal Misconvergence (mm)†	Vertical Pincushioning (mm)†	Horizontal Pincushioning (mm)†
Aamazing CM1528FS	49	20.4	0.150	0.226	0.254	0.495
AcerView 56L	55	19.0	0.368	0.226	0.300	0.518
ADI MicroScan 4A	52	14.1	0.385	0.430	0.335	0.754
AOC CM-536	48	20.2	0.432	0.254	0.681	0.546
Compaq QVision 150 Color Monitor	64	25.0	0.347	0.277	0.310	0.569
Dell UltraScan 15FS	47	25.4	0.176	0.266	0.305	0.272
Dell UltraScan 15LR	45	38.2	0.423	0.172	0.188	0.274
FORA Addonics C152/LR	49	20.1	0.349	0.291	0.478	0.235
Hitachi/Nissey SuperScan 15	56.5	19.2	0.163	0.166	0.544	0.427
IBM PS/ValuePoint 6319 Color Display	42	22.6	0.369	0.261	0.394	0.127
IOcomm ThinkSync 5	60	14.0	0.182	0.365	0.533	0.381
MAG MX15F	52	25.2	0.397	0.456	0.757	0.282
Nanao Flexscan F340iW	59	42.2	0.168	0.227	0.569	0.442
NEC MultiSync 3FGX	68	20.0	0.368	0.329	0.381	0.202
NEC MultiSync 4FG	60	23.1	0.270	0.143	0.470	0.312
Optquest 2000D	54	20.4	0.362	0.210	0.648	0.505
Optquest 2000DX	61	23.7	0.279	0.402	0.533	0.188
Relisys RE-1558	48	26.9	0.227	0.518	0.978	0.572
Sampo AlphaScan 15	51	24.3	0.180	0.239	0.470	0.724
Sunshine CM15C	59	18.0	0.345	0.228	0.853	0.724
Taxan MultiVision 550	55	29.7	0.211	0.374	0.937	0.371
TVM LowRadiation 5A+	52	18.5	0.205	0.213	0.340	0.356
ViewSonic 6	52	20	0.306	0.239	0.213	0.528

* Scores of 50 percent or greater represent acceptable image sharpness

** Scores of 15 foot-lamberts or greater represent acceptable screen brightness

† Lower numbers represent better results

14- and 15-Inch Monitors



The ADI MicroScan 3E, ADI MicroScan 4A, Compaq 1024 Color Monitor, Optique 1500D, and Optique 2000D

imum Horizontal Misconvergence test. In Super VGA mode on the Misconvergence tests, the 15-inch MicroScan 4A and Optique 2000D followed the same pattern they did in VGA mode. None of these monitors showed convergence problems in real-world applications, although they were enough off to let us see misconvergence in subjective tests designed specifically to show misconvergence.

Brightness on the Superspot tests was a bit lower than it should have been for the MicroScan 4A at 800-by-600, but it fell within an acceptable range for its Optique 2000D twin. Such variation is reasonable from one similar monitor to the next. And, more important, even the MicroScan 4A wasn't objectionably dim.

The measured screen size of the MicroScan 3E and the Compaq 1024 is 13.8 inches. While this seems generous, you can see the edge of the mask inside the bezel, leading to an objectionable amount of black to the left and right of the image. While both fill the screen vertically, in SVGA mode they leave a full inch of black horizontally, split between the left and right sides. At VGA resolution, the 3E is even worse, leaving 1.5 inches.

If you want the convenience of digital memory, the MicroScan 3E+ and Optique 1500D, which provide an honest 13.5-inch diagonal measurement, are better 14-inch choices than the somewhat-flawed MicroScan 3E and Compaq 1024. For 15-inch monitors, the MicroScan 4A and Optique 2000D get extra points for their flat square screens.

In choosing between ADI and Opti-

quest, note that ADI's list prices are higher (though this is not always true of the street prices), but the company offers a two-year warranty, as opposed to Optique, which offers a one-year warranty.

Optique offers two other monitors—the 14-inch analog 1000S and the 15-inch 2000DX—which are reviewed separately in this issue. The 2000DX and 2000D have different controls but are otherwise similar.

AOC International (USA)

AOC CMLB-337

AOC CM-536

Qume Peripherals Inc.

Qume QM857

BY JOHN R. QUAIN

The 15-inch advantage may include better performance and more control of your display. That's the lesson to be learned from this trio: the \$579 14-inch AOC CMLB-337, the \$565 14-inch Qume QM857, and the \$699 15-inch AOC CM-536.

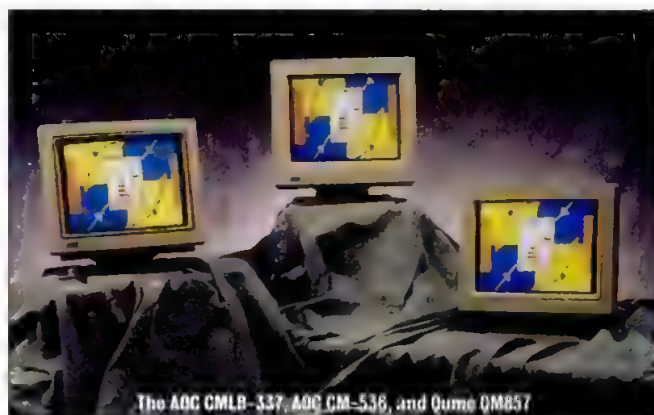
Both analog 14-inch models use a round shadow-mask CRT with a 0.28-mm dot pitch, an etched antiglare screen, and an actual diagonal display area of 13.8 inches. Both of these monitors support up to 1,024-by-768 non-

interlaced resolution at 72 Hz.

The QM857 is built by AOC and is nearly identical to the AOC CMLB-337; both, for example, include MPR II compliance. (MPR II compliance costs \$30 extra for the 15-inch AOC CM-536.) Qume says that the differences between the two 14-inch models are that Qume's monitor adheres to stricter performance requirements, such as low pincushion distortion, and have only Hitachi or Toshiba CRTs.

Superspot testing in VGA mode confirmed that the QM857 had less vertical pincushion distortion than the AOC CMLB-337 and the AOC CM-536. Subjective evaluations did not detect a difference, however. But the QM857's VGA Misconvergence test scores were high in the vertical and horizontal planes.

Both 14-inch models performed well in subjective testing in VGA and Super VGA modes at 72 Hz, offering good, clean images. But moving to 1,024-by-768 at 72 Hz caused some difficulties, with considerable jitter visible in windows filled with text. Dropping the refresh rate



The AOC CMLB-337, AOC CM-536, and Qume QM857

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- 1024x768 Resolution
- 28mm Dot Pitch
- 17" FST Technology

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MODEL MF-5117

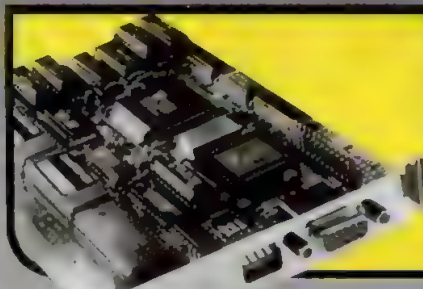
- 20-50 KHz
- 1024x768 Resolution
- 28mm Dot Pitch
- 17" FST Technology

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Diamond Stealth	1024x768, 1 MB, 32K colors	\$649 ⁰⁰	\$769 ⁰⁰	\$1099 ⁰⁰	\$1189 ⁰⁰
Helio TC-1280-16	1280x1024, 1 MB, 16 colors	—	\$819 ⁰⁰	—	\$1239 ⁰⁰
Helio TC-1280-256	1280x1024, 2 MB, 256 colors	—	—	—	\$1399 ⁰⁰
Diamond Stealth 24	1280x1024, 1 MB, 16 colors	—	\$689 ⁰⁰	—	\$1089 ⁰⁰

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14- and 15-Inch Monitors

to 60 Hz alleviated much of the problem, but some subsequent image flicker became noticeable.

Neither 14-inch model performs true autosizing, but the front panel controls have detents, which make it easy to adjust the image. You cannot fully overscan the image and may lose about a quarter of an inch of viewable screen on each side.

To get the full picture—and a sharper image—move up to the 15-inch AOC CM-536. You don't have a much larger visible diagonal display area (14 inches versus 13.8 inches for the 14-inch models), and you don't gain a tighter dot pitch. But the CM-536 offers a maximum noninterlaced resolution of 1,280-by-1,024 at 60 Hz and digital controls that let you overscan the entire image. An on-board microprocessor delivers improved autosizing, with 17 factory presets and 19 user-definable settings.

Using a Toshiba flat square tube, with a conventional shadow mask, the CM-536 has a flatter screen and a brighter, snappier image in Windows than what the 14-inch models offer. Eyes-on examination detected good convergence, though the Superspot testing produced Maximum Vertical Misconvergence test scores that were a little high, and, in SVGA, the Average MTF test score dipped to 48.5 percent. In 1,024-by-768 mode, the CM-536 continued at 72 Hz without difficulty, maintaining a solid image and lacking the moire patterns and grayish tinge around tightly spaced letters that plagued the 14-inch units.

Each monitor offers satisfactory performance at a reasonable cost. Dealer prices on the 14-inch AOC and Qume models range from just below \$400, but the 15-inch AOC CM-536 can be found for around \$500, which would make it the better bargain.

Arche Technologies Inc.

Arche 214MH VGA Monitor

BY CHRISTOPHER BARR

The \$599 Arche 214MH VGA Monitor (with an estimated street price of \$425) is the first in Arche Technologies' new series of 14-inch monitors. The next models in this line, which are due out later this year, will offer more resolution op-

tions and add MPR II compliance.

The fixed-frequency analog Arche 214MH has a 0.28-mm dot pitch and a conventional shadow-mask tube; the spherical screen has a silica compound antiglare coating and an actual diagonal



display size of 13.5 inches. It is one of only a few monitors with a detachable, mini-DB15-to-miniDB15 adapter cable. The maximum noninterlaced resolution is 1,024-by-768, with a vertical refresh rate of 60 Hz. Preset horizontal settings let the unit support 800-by-600 at 72 Hz.

The Arche 214MH turned in consistently solid Superspot test scores, but subjective testing was not quite so positive. With Windows in Super VGA mode, black text on a white background was muddy and gray between characters. Colors were bright, but the screen had constant swimming on the right. DOS images had less waviness. The unit does not autosize, and changing from Windows SVGA to DOS VGA modes involves adjusting the vertical size control to make the image fit. (You must make the image larger for Windows.) All of the controls are located on the front, but there's no horizontal size control to expand the image, leaving you with a narrow image on screen. The problems we experienced in subjective testing and the annoyances we encountered, such as having to constantly adjust the vertical screen size when changing modes, may be reason for some users to look elsewhere.

Compaq Computer Corp.

Compaq QVision 150 Color Monitor

BY M. DAVID STONE

The Compaq QVision 150 Color Monitor, priced at \$793 (with an expected street price of about \$660), has the distinctive look and outstanding image quality of a Zenith flat-tension mask monitor. And indeed, Zenith Data Systems manufactures the 15-inch QVision 150 exclusively for Compaq.

The QVision 150 offers a tight 0.26-mm dot pitch, a 13.4-inch visible diagonal screen size, a noninterlaced resolution of 1,024-by-768 at 72 Hz, and the unusual choice of five BNC connectors on the back. It also offers an antistatic and antiglare coating and proved to be far less susceptible to glare than were most monitors we tested. At 45 pounds, it's heavier and bigger than most 15-inch monitors, making the permanently attached tilt and swivel stand that much more welcome.

The all-digital controls, located just below the screen, are well marked, precise, and easy to use: Make a change and it's automatically stored in digital memory as one of 14 mode settings.

On both our Superspot and subjective tests, the monitor scored well for the most part; it turned in some of the top Luminance and Average MTF



scores. While it had slightly higher-than-expected scores on the Misconvergence tests in both VGA and Super VGA modes, they didn't translate into any noticeable blooming on subjective viewing. The only real problem is that when switching between text and graphics modes, the monitor blanks the screen for nearly two seconds and then takes another second or so before the image settles into position. Even so, the combination of a true flat screen, variable-frequency scanning, digital controls, and superb image makes this monitor an excellent choice.

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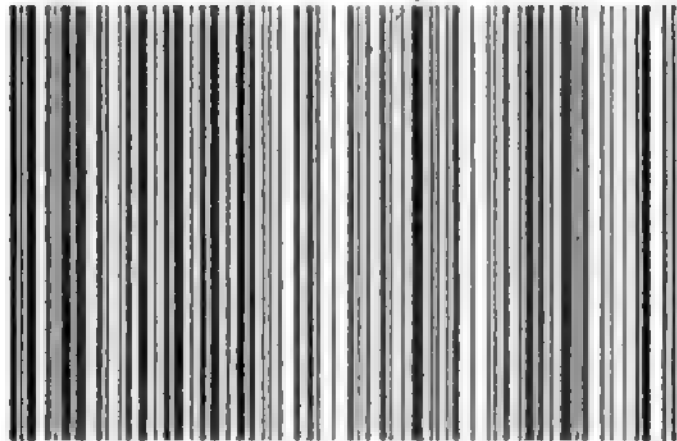




1. Follow instructions on the other side

Back

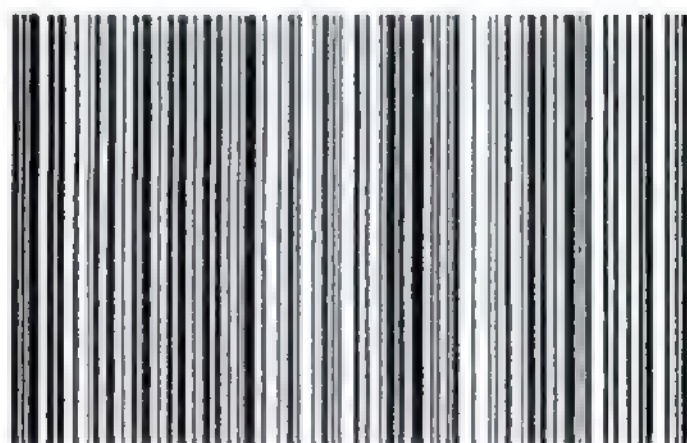
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Inverted Back

1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page

2. Insert this sheet with

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PC Sources echoed *Computer Shopper's* conclusions. "The Nomad 425DXL packs an awful lot of computing into a case that's just 1.7 inches high. Its excellent 79-key keyboard has a great typing feel ... The fine video system includes a large backlit black-on-white LCD ..."

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■ The Case for Monochrome

by Edward Mendelson

A color monitor makes your office more exciting to work in, but there are reasons to consider a monochrome display.

Monochrome monitors typically cost a fraction of the price of color monitors. Some 14-inch Super VGA monochrome monitors list for as little as \$200 to \$300 compared with the \$450-or-higher list prices typical of the 14-inch color monitors in this roundup. Monochrome monitors are available on the street for about \$120 to \$140 (or under \$100 for VGA only), so they are prime candidates for such prosaic duties as file-server display.

Also, monochrome monitors can provide a sharper image than color monitors can because each pixel on a monochrome monitor consists of a single dot. In contrast, each pixel on a color monitor is made of up three dots that are supposed to occupy the same space on-screen but that in fact overlap slightly. The single monochrome dot doesn't guarantee a sharply focused image, but there's a lot less that can go wrong with a single dot than with three.

When all other factors are equal, you may suffer less eyestrain.

With a gray-scale VGA-or-better monochrome monitor, you can use Windows' ordinary VGA or SVGA driver instead of its ugly VGA monochrome driver. Gray scale is generally as easy to work with as color, except in the rare application that uses only red and green (and no words or icons) to distinguish between states of a button or other options.

If you work in character-mode DOS, monochrome mode will give you text underlined on-screen when you select underlined mode. Some users find the color-coded text you get in underlined mode with a color monitor distracting. With a color system, you can usually enter the command `MODE MONO` and get an underline, but you won't have the clear focus you get with a true monochrome monitor.

The biggest problem with monochrome monitors is finding both high quality and high resolution. Some vendors admit that a flood of low-quality, high-flicker units has made producing an SVGA low-flicker monochrome

monitor at a competitive price difficult. IBM Personal Computer Co.'s superb \$245 PS/2 8504 is a 12-inch unit with a refresh rate of up to 70 Hz, which means you won't have to endure flicker. But it supports only VGA.

You have only a few choices if you want SVGA monochrome and you don't need a high-priced, two-page, desktop-publishing model. Unless you go the high-priced, specialist route, monochrome will probably restrict you to a 14-inch screen. Everex Systems offers the 14-inch Evervision Mono SVGA monitor for \$179, with a maximum resolution of 800-by-600 at a 90-Hz refresh rate. Two 14-inch units that go up to 1,024-by-768 resolution and offer refresh rates of 60 Hz at 800-by-600 are Tatung Co. of America's \$259 MM-14SAE SVGA, which meets the MPR Level I emission standard, and TVM Professional Monitor Corp.'s \$199 LowRadiation 3P, which meets the MPR Level II emission standard.

Before you spend a lot on color, try out one of these units. You may decide you can work more clearly in plain black, white, and 64 shades of gray. □

CTX International Inc.

CTX CMS-1461

BY JOHN R. QUAIN

Often bundled with direct market PCs, the 14-inch \$579 CTX CMS-1461 from CTX International is a solidly constructed display. Its etched 0.28-mm dot pitch screen is an ordinary round shadow mask, but the unit's respectable VGA performance and its \$380 street price make the CMS-1461 an option, particularly for those under monetary constraints.

Analog controls on the front let you expand the horizontal and vertical aspects of the image when needed. The actual display area is 13.2 inches.

In standard 640-by-480 mode, this var-

iable-frequency monitor did well on PC Labs' Superspot tests, with a slightly high Maximum Horizontal Misconvergence test score but solid sharpness and brightness (more solid, in fact, than the brightness of most units we reviewed.) Eyes-on evaluation at this resolution turned up no appreciable geometric distortion or transient response problems. Close scrutiny revealed slight misconvergence on the lower right, but nothing that hampered visibility.

At 800-by-600 at 72 Hz, some transient response deficiencies became notice-

able. And 1,024-by-768 mode at 70 Hz taxed the monitor's resources even further. Some Windows images revealed ghosting vertical bands on the left side;

picture adjustments helped somewhat but did not eliminate the problem.

The CMS-1461 supports up to 1,280-by-1,024 interlaced mode at 87 Hz, or up to 1,024-by-768 noninterlaced at 70 Hz. But this monitor is best at the lower resolutions. If you're going to stick to VGA mode and need a simple color display at a reasonable price, the CMS-1461 is worth consideration.



Darius Technology (U.S.) Inc.

Darius HRN-1424

BY BRUCE BROWN

Darius Technology's HRN-1424, a 14-inch analog monitor manufactured in Korea by Daewoo, is a solid, albeit pricey, performer. List-priced at a substantial \$699, the HRN-1424 sells on the street for an average of \$439—still topping quite a few other units in its class.

The 0.28-mm dot pitch model uses a spherical screen with a conventional shadow mask. The bezel-to-bezel measurement is 13.0 inches—one of the smallest visible diagonal screen sizes in this roundup. Its maximum resolution is 1,024-by-768, both interlaced and noninterlaced. The maximum vertical refresh rate is 72 Hz at 800-by-600 mode and 70 Hz at 1,024-by-768 noninterlaced. Several other 14-inch units only manage 60 Hz at noninterlaced 1,024-by-768 mode.

The variable-frequency HRN-1424 uses a combination of screen etching and a 57 percent dark glass tinting for antiglare treatment. In practice, however, there was still a bit of reflection. Superspot testing went smoothly, with only a slightly inflated score on the Maximum Horizontal Misconvergence test. In subjective testing, this monitor delivered even performance, with no muddiness, almost no moiré patterning, and little movement when switching between text and graphics modes. There was a moderate amount of image pulsing in regulation testing, however. You will also find that you need to do a little bit of resizing to maintain image sizes when you switch resolutions.

Darius also sells a 14-inch \$499 VGA-only unit and a \$439 interlaced 1,024-by-768 monitor. Even though the HRN-1424 doesn't have the biggest screen or the lowest street price, it is well designed and worth looking into.

Dell Computer Corp.

Dell UltraScan 14C

Dell UltraScan 14LR

Dell UltraScan 15FS

Dell UltraScan 15LR

FORA Inc.

FORA Addonics C141

Mitsubishi Electronics America Inc.

Mitsubishi Diamond Pro 14

Color Monitor

Sampo America

Sampo AlphaScan Plus

Sampo AlphaScan 15

Taxan America Inc.

Taxan MultiVision 550

BY BRUCE BROWN AND
JOHN R. QUAIN

If you think you're seeing triple, you're right. The \$449 Dell UltraScan 14C, a 14-inch VESA-compliant analog monitor, and the \$449 FORA Addonics C141 are both actually manufactured by Sampo America; the same model is sold by Sampo as its \$695 Sampo AlphaScan Plus. One of Dell's 15-inch monitors is another triplet: The \$549 Dell UltraScan 15FS is also made by Sampo, which sells it as the \$795 AlphaScan 15. Taxan America acquires the same unit from Sampo and sells it for \$799 as its MultiVision 550.

The pairs of triplets give way to a set of twins in the form of Dell's 14-inch \$519 low-radiation Dell UltraScan 14LR (which is manufactured by Mitsubishi Electronics) and the identical \$699 Mitsubishi Diamond Pro 14 Color Monitor.

Finally, Dell sells another 15-inch

model, the rather pricey (\$639) low-radiation Dell UltraScan 15LR. This unit is manufactured by NEC but bears no relation to the NEC MultiSync 3FGX and NEC MultiSync 4FG.

GANG OF THREE

The Dell UltraScan 14C, FORA Addonics C141, and Sampo AlphaScan Plus 14-inch monitors each have a conventional shadow-mask spherical screen tube with a 0.28-mm dot pitch and a 13.2-inch bezel-to-bezel measurement. A silica-compound coating eliminates most glare. Maximum resolution is 1,024-by-768 in interlaced and noninterlaced modes. Each will run at a 72-Hz refresh rate in 1,024-by-768 noninterlaced and in VGA and Super VGA modes.

On VGA Superspot testing, the Sampo AlphaScan Plus was the most consistent, scoring particularly well on the Average MTF test. The FORA Addonics unit fell off slightly on the Maximum Vertical Misconvergence test but otherwise performed within the acceptable range. The Dell had strong Horizontal and Vertical Convergence results but scored above the recommended limit on both pincushioning tests.

In subjective testing, all three of the units were highly consistent, with just a little bit of muddiness seen between tightly packed text. The image size consistency between resolutions was strong, with only minimal adjustments needed. But there was less than rock steadiness in regulation tests and a slight bounce when switching between text and graphics modes. All three had a good deal of moiré.

The advantage of the Dell UltraScan 14C's \$449 list price is somewhat flattened by the fact that there is no discount when you buy from a mail-order house (although the company provides on-site service when you buy this unit—or any of the other Dell units we tested—with a Dell computer). The Sampo AlphaScan Plus has an average street price of about \$400, and the FORA Addonics C141 can be found for \$355.

The significant moiré patterns are probably the worst problem with these monitors. In other respects, performance was consistent enough to make these units worth recommending.





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June 30, 1992
FlexScan F550i



FlexScan F550i

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14- and 15-Inch Monitors

15-INCH TRIO

The 15-inch Dell UltraScan 15FS, Sampo AlphaScan 15, and Taxan MultiVision 550 have many of the same specifications that the 14-inch triplets have, including analog controls and support for a 72-Hz refresh rate at 800-by-600, 640-by-480, and 1,024-by-768 modes. Of these three, Sampo claims that the AlphaScan 15 supports 1,280-by-1,024 at 60 Hz, while Dell and Taxan limit their claims to 1,024-by-768. The flat square screens measure 14

bit in mode switching; the Dell unit had a distinctive, light clicking with each change.

On the street, the Sampo's \$795 list price shrinks to \$550; the Taxan MultiVision 550 typically goes for a higher \$600. Of course, the Dell's \$549 price remains the same. Aside from the problems experienced in testing on two of these three identical monitors, these displays proved to be acceptable, though not overly enticing, choices.

tors delivered slightly better-than-average text clarity in Windows. A screen full of text was cleaner and brighter than it was with most 14-inch monitors we tested, though some transient response sluggishness was noted in the corners, where the spaces between black letters on a white background looked a little gray. Both units switched smoothly between text and graphics modes. The only image flaw worth mentioning was some barrel distortion in SVGA mode.



inches from bezel to bezel. These units don't have true autosizing, but they claim the ability to maintain image sizes for standard VESA video modes.

In VGA Superspot testing, the Dell and the Taxan were above the recommended limit for vertical pincushioning, and the Sampo had high Horizontal Pincushioning scores. In 800-by-600 mode, the Taxan scored much higher than recommended on the Vertical Pincushioning test, as did the Sampo on our Horizontal Pincushioning tests. The UltraScan 15FS's major problem on the SVGA tests was a slightly low Average MTF score.

Subjective testing revealed more differences among these units than it revealed with the 14-inch triplets. For reasons that can probably be ascribed to the sample lots from which these units were drawn, the Sampo AlphaScan 15 and the Taxan MultiVision 550 had greater problems maintaining image size between resolutions and reacted more severely to regulation testing than did the Dell. All three had minimal muddiness and moderate-to-significant moire patterning. The Sampo and Taxan units bounced a

TWO OF A KIND

The \$519 Dell UltraScan 14LR and the \$699 Mitsubishi Diamond Pro 14 are both Mitsubishi-made monitors that offer some high-end features—such as MPR II compliance, stored mode settings, and maximum noninterlaced resolution of 1,024-by-768 at 72 Hz in a bright 14-inch display.

These identical monitors are each able to produce a 72-Hz SVGA image using a 0.28-mm dot pitch, curved shadow-mask antiglare screen with a 13.2-inch actual display area. Even street prices are comparable (at around \$500), since Mitsubishi sells through dealers, and Dell primarily sells direct.

VGA Superspot tests showed respectable Average MTF scores, with solid focus and brightness—a Mitsubishi trademark. There was little detectable misconvergence for either, and the Dell turned in a particularly strong Maximum Horizontal Misconvergence score. Pincushioning tests revealed some appreciable curvature at the sides of images. The Dell was weak with horizontal pincushioning; the Mitsubishi with vertical.

In subjective evaluation, both moni-

Contrast and brightness dials rest beneath the front screen, but making further adjustments involves reaching around the left side to the multifunction toggle switch and two + and – digital controls. Making adjustments can be tricky. To correct pincushioning, for example, you must first power on the monitor while depressing the + and – controls, push both controls simultaneously again, move the toggle to the pincushion setting, and then finally correct the image. The arrangement is one of the most awkward we've ever seen. Most users shouldn't need to play with the controls much, however, since Mitsubishi includes six permanent preset modes, including VGA, Mac II, and 1,024-by-768 standards, as well as six user-definable settings.

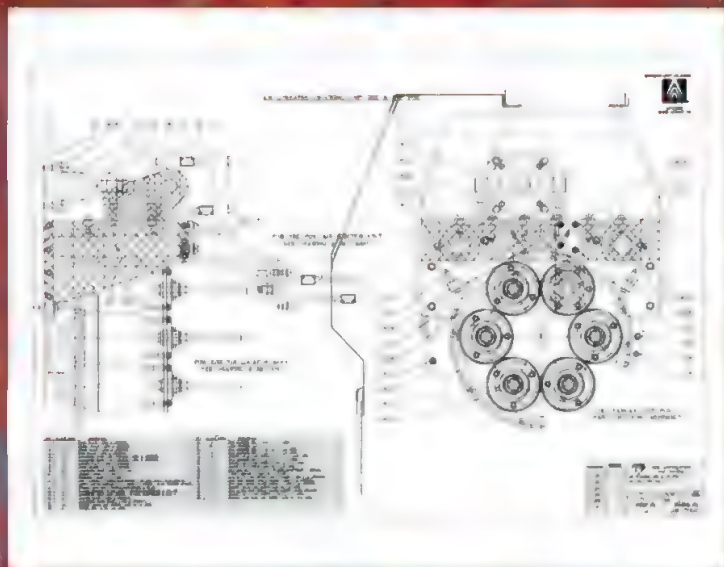
These two Mitsubishi-built monitors each offer a bright image and good clarity, though at a slightly higher cost than most 14-inch competitors. Having easier-to-use controls would make it easier for customers to choose one of these though.

AND FINALLY...

Dell's NEC-made UltraScan 15LR is a low-radiation unit with a flat square

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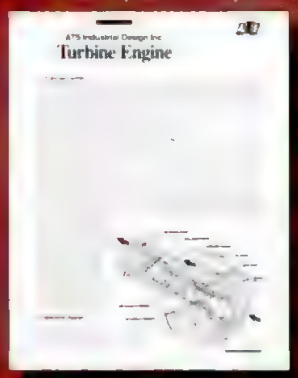
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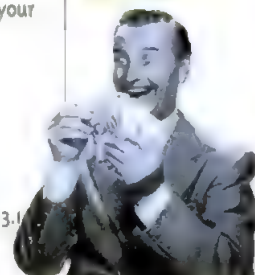
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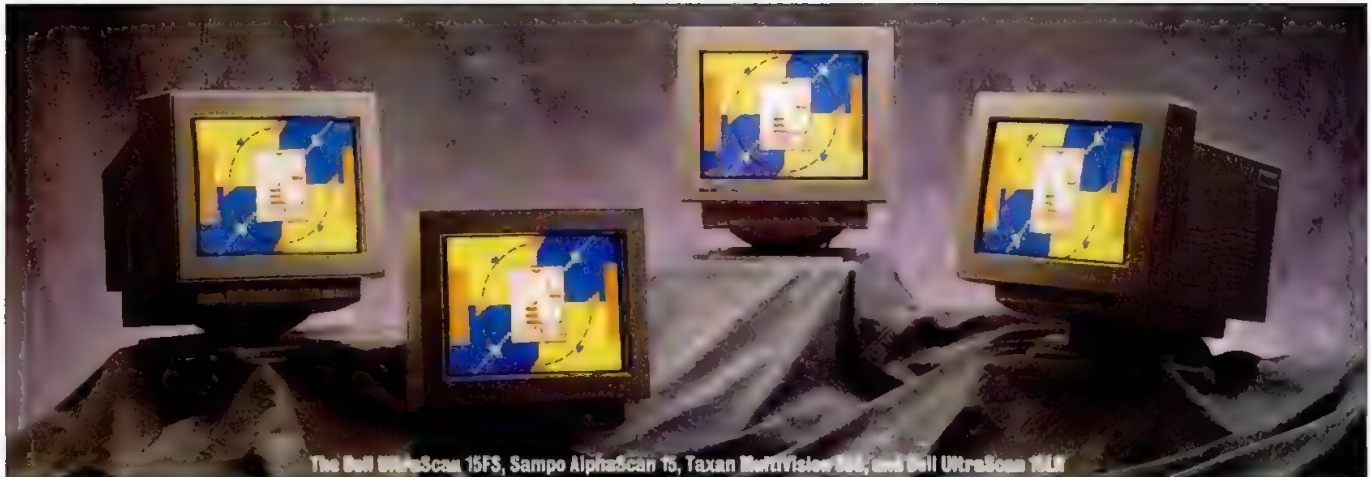
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The Dell UltraScan 15FS, Sampo AlphaScan 15, Taxan Multimedia 14L, and Dell UltraScan 14L

screen that measures 13.7 inches diagonally. This display has a 0.28-mm dot pitch and an Invar shadow mask but lacks standard antiglare protection. Dell doesn't sell NEC screen filters, but you might consider buying one elsewhere if you purchase this unit.

The 15LR supports the same resolutions as the other Dell monitors we tested, but it has a lower maximum vertical refresh rate of 70 Hz in 1,024-by-768 resolution. The 15LR has the usual controls, as well as a pincushion control and a degaussing button.

Superspot testing went smoothly, apart from a slightly low Super VGA Average MTF score and a high SVGA Maximum Vertical Misconvergence score. The SVGA pincushioning test scores were particularly strong. The Dell 15LR has different subjective characteristics than the UltraScan 15FS (and its triplets). The Dell 15LR has little muddiness, minor moire patterns, and no click and almost no bounce on mode switching. The image still jumps in regulation testing, however, and requires size adjustments when modes are changed.

The 15LR is a large, heavy monitor with a very good picture, but its \$639 price is somewhat high compared with the street prices of other 15-inch units, even for a low-radiation design.

Dell also sells three more 14-inch models: one VGA monochrome (\$199), one VGA-only color (\$249), and one interlaced 1,024-by-768 model (\$349). Other FORA 14-inch units include the C143 (reviewed here), the \$299 FORA Addonics C144E VGA model, and the \$359 FORA Addonics C142, a 1,024-by-

768 interlaced SVGA monitor. Sampo also sells a 14-inch 70-Hz SVGA unit (\$495) and a 15-inch 1,280-by-1024 non-interlaced model (\$895).

FORA Inc.

FORA Addonics C143

Optiquet Inc.

Optiquet 1000S

TVM Professional Monitor Corp.

TVM MediaScan 4A+

BY M. DAVID STONE

The \$399 FORA Addonics C143, the \$409 Optiquet 1000S, and the \$455 TVM MediaScan 4A+ are low-end monitors that each feature 14-inch spherical section tubes with a conventional shadow mask, analog controls, and fixed-frequency design. With street prices at about \$369 for the 4A+ and \$310 for the other two, they may be of interest to users on tight budgets.

The FCC identification number these identical monitors share is registered to Continental Systems in Taiwan; according to Acer America Corp., Continental Systems was a previous name for Acer's manufacturing facility. The monitors offer a 0.28-mm dot pitch, a detachable tilt and swivel stand, a maximum noninterlaced resolution of

1,024-by-768 at a 60-Hz vertical refresh rate (in 800-by-600 mode, they manage 72 Hz), and an etched screen that keeps glare to a moderate level. (TVM also offers a low-radiation 14-inch monitor, the \$479 MediaScan 3ALR, which provides Super VGA noninterlaced and 1,024-by-768 interlaced as its top resolutions.)

The adjustment dials on the three units give no resistance, making fine control difficult. Much more troublesome, however, is that you have to readjust the controls every time you change resolutions. This could quickly become tiresome, such as, for instance, when you need to move between DOS in VGA and Windows in SVGA.

On the VGA Superspot tests, the monitors generally performed within the acceptable range. The Misconvergence scores ranged from very good for the



The FORA Addonics C143, Optiquet 1000S, and TVM MediaScan 4A+

TVM 4A+ (0.110 mm on the vertical tests and 0.187 mm on the horizontal tests) to average for the FORA Addonics C143 (0.352 mm and 0.363 mm). But misconvergence was not bad enough to be objectionable for most purposes.

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14- and 15-Inch Monitors

There were a number of notable problems in subjective testing. In SVGA mode, the Optiquess 1000S didn't come close to filling the 13.2-inch visible diagonal screen horizontally or vertically, leaving a total horizontal gap of about 0.5 inches and a total vertical gap of about 0.8 inches. The FORA Addonics C143 and TVM 4A+ did somewhat better, leaving no vertical gap. In VGA mode, the 1000S left a full inch of black vertically and nearly an inch horizontally. The FORA and TVM models did better, leaving just over a 0.5-inch horizontal gap and no vertical gap.

Within this group, the FORA Addonics C143 and Optiquess 1000S are equally good choices, priced at \$50 less on the street than the TVM 4A+. TVM claims it requires more stringent specifications on the 4A+, but on our tests, the differences weren't enough to matter. More significant is the two-year warranty for the TVM 4A+, which compares to one year for the other two.

But keep in mind that you can get 14-inch digital monitors starting at just \$365 or so. These are best for those on tight budgets.

Hitachi/Nissei Sangyo America Ltd.

Hitachi/Nissei SuperScan 15

BY JOHN R. QUAIN

It may not have fancy gimcracks such as digital controls, microprocessor-stored settings, or degaussing and pincushion buttons, but if you're on a budget and you want a 15-inch monitor, the Hitachi/Nissei SuperScan 15 from Hitachi Nissei Sangyo America is worth viewing.

The \$795 list-priced analog SuperScan 15 can be purchased through dealers for around \$420. Its 15-inch screen has a 0.28-mm dot pitch and an actual display area of 13.7 inches. It also has a flat square tube (FST) with an Invar shadow mask and antiglare, silica-coated screen. The permanently attached cable ends in a DB-15 connector on the PC end. The variable-frequency unit supports 72 Hz in 800-by-600 mode and 72 Hz in 1,024-by-768 noninterlaced mode, and it has mode-based autosizing.

PC Labs' Superspot test results for the SuperScan 15 were solid in both resolu-

tions and proved particularly good on the Misconvergence tests. In subjective Windows and DOS viewing, it created virtually no moire patterns, ringing, or streaking. Its few weaknesses included some image bounce on the screen regulation test and some roping on the vertical edges of Windows images in 1,024-by-768 mode. A slight pincushion effect in the corners was also discernible in that mode. The unit's FST screen is flatter and subjectively brighter than most 14-inch models.

Overall, this unit is worth considering if you're looking for a reasonably priced 15-inch monitor and don't plan to go beyond Super VGA.

IBM Personal Computer Co.

IBM PS/ValuePoint 6312 Color Display

IBM PS/ValuePoint 6314 Color Display

IBM PS/ValuePoint 6319 Color Display

BY M. DAVID STONE

IBM Personal Computer Co.'s trio of choices covers the spectrum for 14- and 15-inch monitors. Each product—the \$405 14-inch analog IBM PS/ValuePoint 6312 Color Display, the \$530 14-inch digital IBM PS/ValuePoint 6314 Color Display, and the \$660 15-inch digital IBM PS/ValuePoint 6319 Color Display—qualifies as an acceptable choice, although each has

some drawbacks.

All three offer a 0.28-mm dot pitch, variable-frequency scanning, a maximum noninterlaced resolution of 1,024-by-768 (at 60 Hz for the 6312 and 72 Hz for the others), and an etched screen to combat glare. Both 14-inch monitors

use spherical section tubes with conventional shadow masks, and the 6319 gets points for its flat square tube (FST), which also has a conventional shadow mask. The 6312 hosts a fixed adapter cable that ends in a mini-DB-15 connection, while the other two have mini-DB-15 connections and come with mini-DB-15-to-mini-DB-15 adapter cables.

Controls in each case are in the front, below the screen. The 6312 suffers from having the control wheels mounted directly beneath the screen on the underside of the monitor, where their icon labels are hidden from certain angles by the bottom edge of the bezel. But the wheels offer smooth, reasonably precise control.

The 6314 and 6319 front panels are similar, with digital controls for most functions—including pincushioning and trapezoidal distortion. Each unit also has a digital Color Temperature control, which had no apparent effect on color images. The documentation is unclear as to what effect this control should have, and IBM never adequately answered our queries.

These two monitors do not provide



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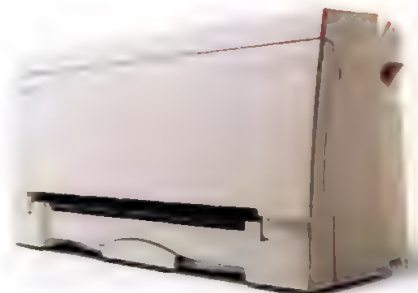
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14- and 15-Inch Monitors

separate controls for each function. To change settings, you first use a mode button to cycle through a set of status lights (which identify functions such as vertical or horizontal positioning) and then an up/down button to adjust the setting. Both the 6314 and 6319 can hold settings for 13 modes, but saving changes is clumsy; you have to hold the save and mode buttons down until the status lights blink three times. A saving grace is that the controls are smooth and precise.

All three monitors performed generally up to par on our Superspot tests, although the 6314 and 6319 produced scores that were slightly high on the Misconvergence tests, particularly in the vertical plane. But neither suffered from noticeable blooming problems on subjective viewing. Horizontal Pincushioning test results were a little high for the 6314, but we had no problems adjusting the pincushioning control to our satisfaction on the subjective tests.

The 6312 showed no moire pattern, but it left a sizable black border around the 13-inch diagonal visible screen. And you'll probably need to adjust the screen settings when changing resolutions. The 6314 and 6319 adequately fill their respective 13.2-inch and 13.6-inch diagonally measured visible screen sizes, and they didn't show much of a moire pattern. On brightness-versus-thickness tests, however, thinner lines were less bright.

None of these monitors, which IBM typically sells as part of its new line of ValuePoint systems, had been available for long enough at this writing to establish a typical street price. If you assume a 15- to 20-percent discount, each qualifies as a reasonable choice.

IOcomm International Technology

IOcomm ThinkSync 4E

IOcomm ThinkSync 5

BY BRUCE BROWN

The \$495 14-inch ThinkSync 4E and the \$795 15-inch ThinkSync 5 from IOcomm International Technology are notable for their high-resolution abilities; the 14-inch model displays up to 1,280-by-1,024, and the ThinkSync 5 supports up to 1,600-by-1,200. But you probably won't want to



run at these maximum interlaced resolutions because of the units' limited screen size. Keep in mind, however, that the ThinkSync 4E's and the ThinkSync 5's respective 13.5-inch and 14-inch visible diagonal screen sizes are at least equal to and often larger than the screens of many of their respective competitors.

The highest noninterlaced mode for the ThinkSync 4E is 1,024-by-768; the ThinkSync 5 supports up to a 1,280-by-1,024 noninterlaced mode. Both variable-frequency scanning units have 0.28-mm dot pitch conventional shadow mask screens with moderately effective screen etching to cut glare. You will have to re-adjust both when switching resolutions. The ThinkSync 4E, priced at an attractive \$350 on the street, has most of the basics in analog controls, but it was one of only a handful of monitors we tested that lacked a control for horizontal size.

Superspot testing showed no problems; subjective tests revealed little tight-text muddiness and no noise or bounce on text-to-graphics mode switches. But the ThinkSync 4E had a moderate amount of moire patterning and was unsteady in regulation testing.

The ThinkSync 4E has vertical refresh rates of 60 Hz in 1,024-by-768 mode and 72 Hz in Super VGA and VGA. The two 72-Hz modes are more appropriate for a monitor of this size and offer the best flicker-free performance.

The ThinkSync 4E's horizontal scanning frequency range is continuous from 31.5 to 38 kHz and then jumps to 48 kHz to support 1,280-by-1,024 mode. But a better deal may be IOcomm's 14-inch ThinkSync 4. Priced at \$100 less, this unit lacks support for 1,280-by-1,024 mode, which you probably won't want to use on

a 14-inch display, in any case.

THINKSYNC 5

The 15-inch model, which includes a mini-DB-15-to-mini-DB-15 adapter cable, supports a maximum 76-Hz refresh rate in 1,024-by-768 mode and 800-by-600 non-interlaced modes. On the Luminance test

at 800-by-600, the ThinkSync 5 scored slightly below the recommended level. Its subjective test results were similar to the 4E's, but it created less moire patterning.

The ThinkSync 5 has only a Class A rating, however, and its \$575 street price makes it a less-aggressively priced model than the 4E. You can find better bargains.

MAG InnoVision

MAG LX1460

MAG MX14S

MAG MX15F

BY JOHN R. QUAIN

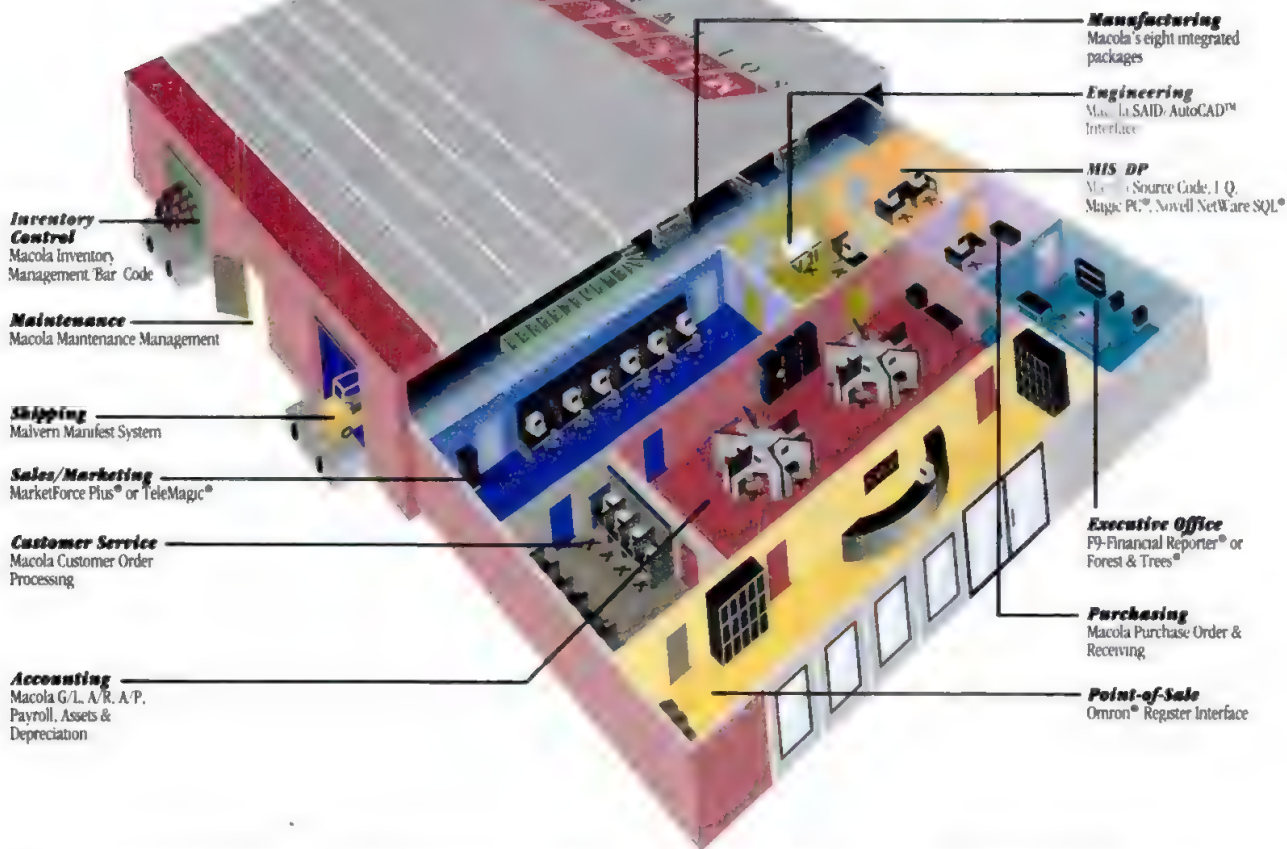
Premium monitors can command a premium price. What you get for your money with these three outstanding MAG monitors—the \$449 14-inch MAG LX1460, the \$799 14-inch MAG MX14S, and the \$899 15-inch MAG MX15F—are precise controls, higher resolutions, mode-based autosensing, and attention to detail.

Even MAG's budget LX1460 (street-priced near \$400) offers extensive controls. In addition to the standard analog front-panel position and size dials, it has a rear-panel degaussing button, pincushion control, and gun-focus adjustment.

The LX1460 uses a conventional cathode-ray tube (CRT) with a 0.28-mm dot pitch and offers a 13.5-inch visible diagonal screen size. It supports a 72-Hz refresh rate in 1,024-by-768 noninterlaced mode and claims 85 Hz in Super VGA.

The MX14S, which costs about \$550 from dealers, uses a Sony Trinitron tube with a 0.25-mm aperture grill and has an actual display area of 13 inches. Its top resolution is 1,280-by-1,024 at 60 Hz, and

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14- and 15-Inch Monitors



it handles up to 76 Hz in 800-by-600 and 1,024-by-768 noninterlaced modes.

The MX14S offers easily accessible front-panel digital controls with 17 memory settings (8 are user-definable). The controls require some practice, but storing mode settings is simple enough.

With controls and resolution capabilities matching those of the MX14S, the MAG MX15F adds a larger screen, with an actual visible display area of 13.8 inches. Selling through dealers for about \$600, the MX15F is based on a flat square tube CRT with an Invar shadow mask and 0.28-mm dot pitch.

Comparing the picture performance of the three units is a lesson in the distinct differences among CRTs. The conventional tube of the least-expensive LX1460 has a slightly softer focus than the other two have. It doesn't appear as bright as the others, though it has good convergence and line-width consistency.

The Trinitron tube of the MX14S produces the sharpest text in Windows applications. Convergence is excellent, and color registration is close to perfect. However, when reaching for its highest supported resolutions, the MX14S reveals some pincushioning distortion.

The FST-based MX15F combines the best features of the other two. The MX15F is sharper than the LX1460 and nearly as crisp as the Sony-based MX14S. It also lacks the pincushioning problems of the latter.

In Superspot VGA mode, all had good image detail—reflected in their Average MTF results—and the MX14S and LX1460 delivered strong Luminance test results. But both the MX14S and the MX15F had high Vertical Pincushioning test scores. The MX15F also had very

again, these problems were not apparent to the naked eye.

Those seeking a 15-inch unit to take graphics up to 1,024-by-768 mode may find the MAG MX15F most appealing.

Mitsuba Corp.

Mitsuba 710VX

BY CHRISTOPHER BARR

Mitsuba's \$469 710VX is a 14-inch analog monitor with an affordable street price near \$370. But poor subjective test results make the unit we tested less than ideal.

The fixed-frequency scanning 710VX has a 0.28-mm dot pitch, a round tube with a conventional shadow mask, an antiglare screen, and a relatively small visible display area of 13 inches. In 1,024-by-768 noninterlaced mode, the unit supports a vertical refresh rate of 60 Hz. Mitsuba also sells a variety of less-expensive 14-inch models.

The unit performed solidly on Superspot testing, with particularly strong VGA Misconvergence scores. On subjective tests, while running Windows in Super VGA mode at a 72-Hz refresh rate, the monitor didn't flicker, and it showed bright, vibrant colors; but black text on a white background was muddy, and there was ghosting in bands of black and white. Under DOS in VGA mode, the vertical lines on the screen's left side weren't as bright as they were on the

high Misconvergence scores, though neither these nor its pincushioning scores had any negative consequences in subjective viewing. In SVGA mode, the MX15F's Misconvergence scores were a little high, and vertical pincushioning was above the recommended limit. But

right. Horizontal lines seemed brighter than vertical lines, and the unit showed distracting, wavy visual patterns.

The 710VX's documentation is skimpy, and determining the preset timings is difficult. This unit has most of the basic controls but lacks a horizontal-size control, so you can't expand the image farther out to the bezel limit. The horizontal- and vertical-position controls, along with the vertical-size control, are inconveniently located on the back of the monitor. Stronger alternatives are available among the other units tested.

Nanao USA Corp.

Nanao Flexscan F340iW

BY M. DAVID STONE

The \$899 Nanao Flexscan F340iW from Nanao USA Corp. can be described in two words: Simply outstanding. With a street price that starts at about \$725, it's one of the more expensive monitors in this review, but it is well worth the price.

The F340iW offers a 0.28-mm dot pitch, a 15-inch flat square tube with an Invar shadow mask, variable-frequency scanning, silica-compound coating to fight glare, and maximum refresh rates of 76 Hz at 1,024-by-768 noninterlaced mode and 90 Hz at 800-by-600.

The digital controls encompass a plethora of options, including choices for

pincushioning, trapezoidal distortion, and color matching. The digital controls are unusual because they include an analog-style wheel. The wheel is analog in mechanics only, adjusting settings in precise, digital steps. You use a select button to cycle through the control

choices and then use the wheel to adjust the selected choice. To store the setting, you press the Enter button. The memory can store up to 28 mode settings. The unit also offers a standby power control, which saves on electricity consumption.

The monitor managed mostly fine scores on the Superspot tests. Its Vertical



14- and 15-Inch Monitors

Pincushioning test scores in both VGA and Super VGA modes, however, were high: 0.973 and 0.569, respectively. But the unit's pincushion control made this showing a nonissue on subjective tests. The unit performed far better than most other monitors in virtually all subjective testing. It showed practically no distortion and exhibited no moiré pattern, and the characters on the tight-text test came across as the cleanest and crispest of all. Solid screen regulation, a lack of bouncing when switching between text and graphics modes, and a generous 13.8 inches of visible screen size add to the unit's overall appeal.

If you want the best in 15-inch monitors, and are willing to pay for it, you'll find it difficult to do any better than this.

NEC Technologies Inc.

NEC MultiSync 3FGX

NEC MultiSync 4FG

BY JOHN R. QUAIN

Two of the most popular color monitors in offices today are NEC's 15-inch MultiSync 3FGX and 4FG—and for good reason. They set standards that most of the competition is still trying to match.

These units reflect NEC's recent policy that abandons "suggested list prices" in favor of "estimated sales prices," which are \$635 for the 3FGX and \$759 for the 4FG. These prices are intended to better reflect street prices.

Both monitors feature a 0.28-mm flat square tube with an Invar shadow mask; each has an actual display area of 13.8 inches. Both units handle a VGA or Super VGA signal at 72 Hz, use mode-

based autosizing, and eschew antiglare coating in favor of a clear screen to improve brightness.

Depending on lighting conditions, however, the shiny screens can create a small or significant glare. NEC offers a standard and a dark antiglare lens (\$69 each) that fit neatly over MultiSync screens. The standard lens works well in most settings, but you may need the darker lens in sunny environments.

The MultiSync 3FGX will display a maximum resolution of 1,024-by-768 noninterlaced at only 60 Hz, and the 4FG can reach 70 Hz at that noninterlaced resolution. Unlike the analog 3FGX, the 4FG comes with digital controls and a microprocessor with 19 memory settings.

Arranged like the four points of a compass, the 4FG's digital size and position controls are extremely easy to use. The buttons also serve double duty as pincushion and RGB color-correction controls. NEC calls the latter feature AccuColor. It enables you to match the monitor's display colors to your color output.

In subjective evaluation, the MultiSync 3FGX proved to be a clean display, with solid blacks, fully saturated colors, and good screen uniformity. In SVGA running Windows, it did exhibit some minor roping distortion at the screen edges. It also showed a tiny amount of misconvergence in the screen's lower-right-hand corner.



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The broader video bandwidth of the MultiSync 4FG (75 MHz versus 65 MHz) meant that in the same tests, the 4FG did not exhibit even these slight imperfections. The 4FG's transient response was unimpeachable, with closely spaced letters that were sharp and distinct; color alignment was nearly perfect.

The Superspot supported our observations. The 3FGX had the most precise picture among the monitors we tested, scoring the highest Average MTF in both modes. For both units, Pincushion test results were acceptably low at both resolutions. Both, however, earned slightly high scores on our vertical Misconvergence test in VGA; the 3FGX scored highly in SVGA as well. The 4FG had particularly good Maximum Horizontal Misconvergence test scores in both modes.

There are less expensive monitors with nearly the same features as these two from NEC, but we continue to be impressed by the company's attention to picture quality. For those who can't afford to make compromises, the MultiSync 3FGX and 4FG are still the monitors of choice.

Neotec Graphic International Inc.

Neotec NT-1456

BY BRUCE BROWN

The 14-inch Neotec Graphic International NT-1456, made in Taiwan by Bridge Information, lists for \$365 and sells on the street for nearly \$350. But price isn't its only appeal: The NT-1456's autosizing works well for a relatively low-cost monitor.

The unit uses a spherical screen cathode-ray tube with a conventional shadow



Monitors: The Facts on File

CONTINUES

Aamazing Technologies

1050 W. Beacon, Brea, CA 92621; 714-255-1688; fax, 714-255-1686

Aamazing CM8428MX List price: \$499. 501 ON READER SERVICE CARD	In short: The 14-inch Aamazing CM8428MX offers solid performance at an appealing price—as low as \$329 on the street.
Aamazing CM1528FS List price: \$699. 502 ON READER SERVICE CARD	In short: Like its sibling, the 15-inch Aamazing CM1528FS is a steady performer with an aggressive street price (\$479). It adds support for a 72-Hz refresh rate at 1,280-by-1,024 and 74 Hz at 1,024-by-768 and lower noninterlaced resolutions

Acer America Corp.

2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237, 408-432-6200; fax, 408-432-6221

AcerView 56L List price: \$899. 503 ON READER SERVICE CARD	In short: The AcerView 56L offers a 15-inch flat square tube, digital memory and controls, and a maximum resolution of 1,024-by-768 at 72 Hz. It's a step below the top tier in overall capability, but it has a good street price
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ADI Systems Inc.

2115 Ringwood Ave., San Jose, CA 95131; 800-228-0530, 800-675-7322 (in California), 408-944-0100; fax, 408-944-0300

ADI MicroScan 3E List price: \$649 504 ON READER SERVICE CARD	In short: The 14-inch digital ADI MicroScan 3E offers a maximum noninterlaced resolution of 1,024-by-768 at 60 Hz. However, it suffers from an objectionable amount of black border to the left and right of the image. The ADI MicroScan 3E+ doesn't have these flaws and costs only a little more.
ADI MicroScan 3E+ List price: \$749. 505 ON READER SERVICE CARD	In short: The \$749 ADI MicroScan 3E+ offers digital controls, digital memory, and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz, which adds a little style to a 14-inch monitor. The essentially identical \$499 Optique 1500D costs a little less, but ADI offers a longer warranty
ADI MicroScan 4A List price: \$859. 506 ON READER SERVICE CARD	In short: The MicroScan 4A offers a 15-inch flat square tube, digital controls and memory, and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz. A two-year warranty adds further enticement to an attractive 15-inch choice.

AOC International (USA)

770 Charcot Ave., San Jose, CA 95131; 800-343-5777, 408-954-0325; fax, 408-954-1041

AOC CMLB-337 List price: \$579 507 ON READER SERVICE CARD	In short: The 14-inch AOC CMLB-337 analog monitor provides a reasonable alternative for users on a budget. Front panel controls are easy to use, the visible diagonal screen size is generous for this class, and the screen is etched to fight glare
AOC CM-536 List price: \$699 508 ON READER SERVICE CARD	In short: The 15-inch AOC CM-536 offers a flatter screen, sharper images, and a higher maximum resolution than the 14-inch CMLB-337 and identical 14-inch Dume QM857 offer. For about \$100 more on the street than either of them, the CM-536 is the better bargain

Arche Technologies Inc.

48502 Kata Rd., Fremont, CA 94538; 800-437-1688, 510-623-8100; fax, 510-683-6754

Arche 214MH VGA Monitor List price: \$599 509 ON READER SERVICE CARD	In short: The first of Arche's new 14-inch monitors, the \$599 Arche 214MH VGA Monitor suffers from weak subjective testing results. It lacks a horizontal size control, and you must adjust the image size when switching from Windows Super VGA to DOS VGA modes
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Compaq Computer Corp.

P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670

Compaq 1024 Color Monitor List price: \$441. 510 ON READER SERVICE CARD	In short: Similar to the ADI 3E+, but somewhat lower in cost, the 14-inch Compaq 1024 Color Monitor offers digital controls, digital memory, and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz. But it is hindered by an objectionable amount of black border to the left and right of the image
Compaq QVision 150 Color Monitor List price: \$793. 511 ON READER SERVICE CARD	In short: The Compaq QVision 150 offers a 15-inch Zenith true flat screen, a tight 0.26-mm dot pitch, all-digital controls, and a noninterlaced resolution of 1,024-by-768 at 72 Hz. This monitor proves itself to be one of the better models available

CTX International Inc.

20530 Earlgate St., Walnut, CA 91789; 714-595-6146; fax, 714-595-6293

CTX CMS-1461 List price: \$579 512 ON READER SERVICE CARD	In short: A solidly built contender in the 14-inch class, the CTX CMS-1461 offers reliable VGA performance at a reasonable price. Budget-minded users who don't need higher resolutions should look into this one
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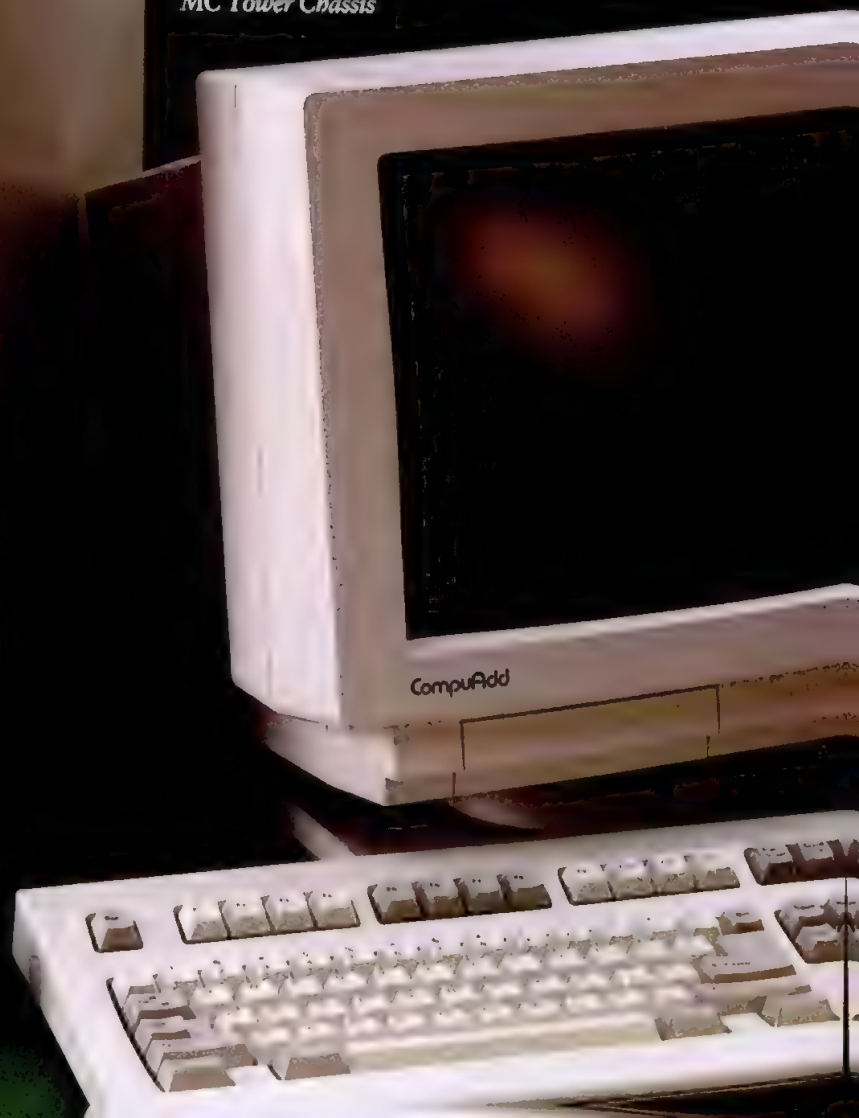
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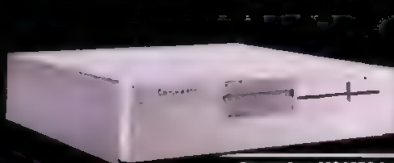
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14- and 15-Inch Monitors

mask and 0.28-mm dot pitch; the visible diagonal screen size is 13.4 inches. The unit has the expected analog controls and a permanently affixed cable. The anti-glare glass tinting allows about the same limited glare and reflection as etching.

The top noninterlaced resolution is an uncommon (and probably impractical, for this size display) 1,280-by-960. At 800-by-600 mode, the unit runs at 72 Hz, and unlike many of its 14-inch peers, it supports the VESA-recommended 70 Hz for 1,024-by-768 noninterlaced mode.

Superspot tests showed no problems, apart from a slightly high Maximum Horizontal Misconvergence score in VGA. Subjective testing results were also good, with minimal tight-text muddiness and moire patterning. The autosizing circuitry on this variable-frequency unit held tight control of image size—convenient if you switch resolutions often. But the image wasn't rock solid in regulation testing, and it jittered on text-to-graphics mode switch testing.

Overall, the Neotec NT-1456 is a good deal, with decent performance and consistent image sizing.

Packard Bell Electronics

Packard Bell PB8548SVGL

BY CHRISTOPHER BARR

Packard Bell's 14-inch monitor is an average-performing unit that can be purchased in computer superstores, consumer electronic stores, and just about every place else. It can't, however, be purchased directly from the company. While the PB8548SVGL has no list price, Packard Bell claims an "estimated street price" of \$399.95.

With a 0.28-mm dot pitch, a visible screen size of 13.3 inches, and a spherical CRT with a conventional shadow mask, the PB8548SVGL is solid and well constructed. It can reach a maximum noninterlaced resolution of 1,024-by-768 at a 60-Hz vertical refresh rate. It has preset timings to match a 72-Hz refresh rate at 640-by-480 and 800-by-600. Other than the horizontal- and vertical-positioning controls, the analog controls are located on the front.

The unit generated moderate Superspot scores on all but the Vertical Pin-

Monitors: The Facts on File

CONTINUES

Darius Technology (U.S.) Inc.

22028 26th Ave. SE, Bothell, WA 98021; 800-873-8288, 206-483-8889; fax, 206-486-2577

Darius HRN-1424

List price: \$699.

513 ON READER SERVICE CARD

In short: The 14-inch analog Darius HRN-1424 is a well-built unit and a solid performer. But at \$699 list and \$439 on the street, it is priced above many other 14-inch monitors in this review.

Dell Computer Corp.

9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 800-727-8320

Dell UltraScan 14C

List price: \$449.

514 ON READER SERVICE CARD

In short: The Dell UltraScan 14C provides the same range of benefits as the identical FORA Addonics C141 and Sampo AlphaScan Plus offer, including consistent performance and little need for sizing adjustments when switching modes. But at \$449 (mail order), the Dell is a little more costly than its cousins.

Dell UltraScan 14LR

List price: \$519.

515 ON READER SERVICE CARD

In short: The Dell UltraScan 14LR is identical to the Mitsubishi Diamond Pro 14. Like that monitor, this unit offers some attractive high-end features.

Unfortunately, the digital controls are so awkward, most users will find them a deterrent rather than a benefit.

Dell UltraScan 15FS

List price: \$549.

516 ON READER SERVICE CARD

In short: At \$549, the Dell UltraScan 15FS proves itself a reasonable performer for the price. Among its benefits are a flat square screen and the ability to steadfastly maintain image sizes when changing resolutions.

Dell UltraScan 15LR

List price: \$639.

517 ON READER SERVICE CARD

In short: The Dell UltraScan 15LR did well on subjective testing, but glare is a factor with this NEC-made monitor, and you'll have to look to another vendor for an antiglare screen. This unit's main drawback is that it is priced a little above most of its 15-inch competition.

FORA Inc.

3096 Orchard Dr., San Jose, CA 95134; 408-943-0100; fax, 408-943-0642

FORA Addonics C141

List price: \$449.

518 ON READER SERVICE CARD

In short: Identical to the Dell UltraScan 14C and the Sampo AlphaScan Plus, the FORA Addonics C141 has a street price of \$355, making it the best price/performance bargain of the three.

FORA Addonics C143

List price: \$399.

519 ON READER SERVICE CARD

In short: Low-priced and low-end, the FORA Addonics C143 is a 14-inch monitor with a spherical section tube, analog controls, and fixed-frequency design. It will appeal most to users on a tight budget.

FORA Addonics C152/LR

List price: \$599.

520 ON READER SERVICE CARD

In short: The Addonics C152/LR offers all the same advantages as its identical siblings, the AcerView 56L, Optquest 2000DX, and ViewSonic 6FS provide—with the added benefit of a lower price than any of those units.

Hitachi/Nissei Sangyo America Ltd.

800 South St., Waltham, MA 02154; 800-441-4832, 617-893-5700; fax, 617-647-1125

Hitachi/Nissei

SuperScan 15

List price: \$795.

521 ON READER SERVICE CARD

In short: With clear, respectable Super VGA image performance, the Hitachi SuperScan 15 offers buyers a 15-inch display at a street price competitive with prices of some 14-inch models.

IBM Personal Computer Co.

Rt. 100, Somers, NY 10589; 800-426-2968; fax, 800-426-4329

IBM PS/ValuePoint 6312

Color Display

List price: \$405.

522 ON READER SERVICE CARD

In short: IBM's low-end analog 14-inch monitor offers a maximum noninterlaced resolution of 1,024-by-768 at 60 Hz. It's a safe buy, if you don't mind some poorly positioned controls and a black border that takes up more of the screen than it should.

IBM PS/ValuePoint 6314

Color Display

List price: \$530.

524 ON READER SERVICE CARD

In short: With its digital controls, digital memory, and 1,024-by-768 noninterlaced resolution at 72 Hz, the 6314 qualifies as a high-end 14-inch monitor. Storing settings is a little clumsier than it might be—but not enough to be a serious problem.

IBM PS/ValuePoint 6319

Color Display

List price: \$660.

523 ON READER SERVICE CARD

In short: The unit offers a 15-inch flat square tube, digital controls, digital memory, and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz. As with IBM's 6314, storing settings is a little clumsier than you might like.

IOcomm International Technology

12700 Yukon Ave., Hawthorne, CA 90250; 800-998-8919, 310-644-6100, fax, 310-644-6068

IOcomm ThinkSync 4E

List price: \$495.

525 ON READER SERVICE CARD

In short: The 14-inch ThinkSync 4E has an attractive street price and decent performance, but a better bargain may be the ThinkSync 4 for \$100 less. ThinkSync 4 lacks the ThinkSync 4E's support for 1,280-by-1,024 mode, but you probably won't run in that mode on a monitor of this size, anyway.

IOcomm ThinkSync 5

List price: \$795.

526 ON READER SERVICE CARD

In short: A Class A rating, generally decent but certainly not exceptional performance, and a less-aggressive price than its 14-inch sibling make the ThinkSync 5 a less-than-compelling choice in its class of 15-inch peers.

14- and 15-Inch Monitors



cushioning test. Here, its score more than doubled the recommended measurement. On our subjective tests, it managed middling performance. Under Windows at an 800-by-600 resolution at 72 Hz, the unit showed slight ghosting on the left border. The colors were good and bright, but the black text characters on a white background were out of focus. The unit also showed slight waving on the moire tests.

Though not outstanding, the PB8548SVGL delivers satisfactory performance at a moderate price.

Philips Consumer Electronics Co.

Magnavox MagnaScan/14 Model CM9214

BY JOHN R. QUAIN

If you think that all you'll get out of a new monitor is a better image, Philips has something you should hear. Packed into its 14-inch \$549 Magnavox MagnaScan/14 Model CM9214 is a tiny 1-watt-per-channel stereo amplifier with two internal speakers.

Marketed under the Magnavox brand name, the MagnaScan/14 not only plays sound with your graphics but also enables private listening via a front-panel mini headphone jack and volume control. On the back, dual RCA-style jacks accept stereo audio input from a CD-ROM or a sound board.

The monitor itself is based on a conventional spherical CRT with a 0.28-mm dot pitch, etched screen, and an actual viewing area of 13.2 inches. The MagnaScan/14 will handle VGA and Super VGA resolutions with a 72-Hz vertical

Monitors: The Facts on File

CONTINUES

MAG InnoVision

4392 Corporate Center Dr., Los Alamitos, CA 90720; 800-827-3998, 714-827-3998; fax, 714-827-5522

MAG LX1460

List price: \$449.

527 ON READER SERVICE CARD

In short: The \$449 14-inch MAG LX1460 is MAG's budget model, but this analog conventional display comes with plenty of controls and offers solid performance.

MAG MX14S

List price: \$799.

528 ON READER SERVICE CARD

In short: The \$799 14-inch MX14S is based on a Sony Trinitron tube, with a 0.25-mm aperture grill, extensive digital controls, and 17 user settings. You get the best sharpness of this group, though the MX15F still has the advantage in overall performance.



MAG MX15F

List price: \$899

529 ON READER SERVICE CARD

In short: The \$899 15-inch MX15F has a strong appeal with MAG's sharp quality image and extensive controls. Based on a flat square CRT with an Invar shadow mask, the MX15F offers a larger actual viewing area than the MX14S provides (13.8 versus 13.0 inches). Put this one on your list.

Mitsuba Corp.

1925 Wright Ave., La Verne, CA 91750; 800-648-7822, 714-392-2000; fax, 714-392-2021

Mitsuba 710VX

List price: \$469.

530 ON READER SERVICE CARD

In short: The 14-inch analog Mitsuba 710VX didn't have the same quality of display as some other vendors' models that cost the same or just a little more.

Mitsubishi Electronics America Inc.

5665 Plaza Dr., P.O. Box 6005, Cypress, CA 90630-0007; 800-843-2515, 714-236-6352; fax, 714-236-6172

Mitsubishi Diamond Pro 14 Color Monitor

List price: \$699.

531 ON READER SERVICE CARD

In short: The \$699 14-inch Mitsubishi Diamond Pro 14 offers a bright image and good clarity but suffers from the same set of awkward digital controls as the Dell UltraScan 14LR. Otherwise, the monitor presents a reasonable, though not the most economical, buy.

Nanao USA Corp.

23535 Telo Ave., Torrance, CA 90505; 800-800-5202, 310-325-5202; fax, 310-530-1679



Nanao Flexscan F340iW

List price: \$899

532 ON READER SERVICE CARD

In short: The Nanao Flexscan F340iW is impressive. Features include a 15-inch flat square tube, digital controls, color matching, and maximum refresh rates of 76 Hz at noninterlaced 1,024-by-768 mode and 90 Hz at 800-by-600. The monitor also excelled in virtually all the subjective tests.

NEC Technologies Inc.

1255 Michael Dr., Wood Dale, IL 60191; 800-388-8888, 708-860-9500; fax, 800-366-0476

NEC MultiSync 3FGX

Estimated sales price:

\$635, dark or standard

tint lenses \$69

533 ON READER SERVICE CARD

In short: The unit is the lower end of the two NEC products in this review, offering analog controls and a lower vertical refresh rate at its highest noninterlaced resolution. But like the NEC MultiSync 4FG, the 3FGX continues to set the pace that other monitors in this class follow.



NEC MultiSync 4FG

Estimated sales price:

\$759; dark or standard

tint lenses \$69

534 ON READER SERVICE CARD

In short: As with the NEC MultiSync 3FGX, the 4FG is a standard bearer of color monitors. Its exemplary features include a microprocessor, digital controls, color matching, and a 70-Hz vertical refresh rate in 1,024-by-768 noninterlaced mode. But with NEC's new pricing strategy, don't expect huge street discounts.

Neotec Graphic International Inc.

20468 Carrey Rd., Walnut, CA 91789; 714-595-0509; fax, 714-594-1968

Neotec NT-1456

List price: \$365.

535 ON READER SERVICE CARD

In short: The 14-inch \$365 Neotec NT-1456 has autosizing abilities that work very well. Picture quality is good, the VESA-recommended refresh rates are supported for both 800-by-600 and 1,024-by-768 modes, and the price is right.

Optquest Inc.

20490 E. Business Pkwy., Walnut, CA 91789; 800-843-6784, 909-468-3750; fax, 909-468-3770

Optquest 1000S

List price: \$409.

536 ON READER SERVICE CARD

In short: The Optquest 1000S is a monitor for those users on a budget. In subjective testing, the reviewed unit had greater problems filling the screen than the identical FORA Addonics C143 and TVM MediaScan 4A+.



Optquest 1500D

List price: \$499

537 ON READER SERVICE CARD

In short: If you're willing to trade a longer warranty for a lower price, the Optquest 1500D provides a good bargain for a 14-inch monitor, matching the ADI MicroScan 3E+ feature for feature, and selling for about \$35-\$65 less on the street.

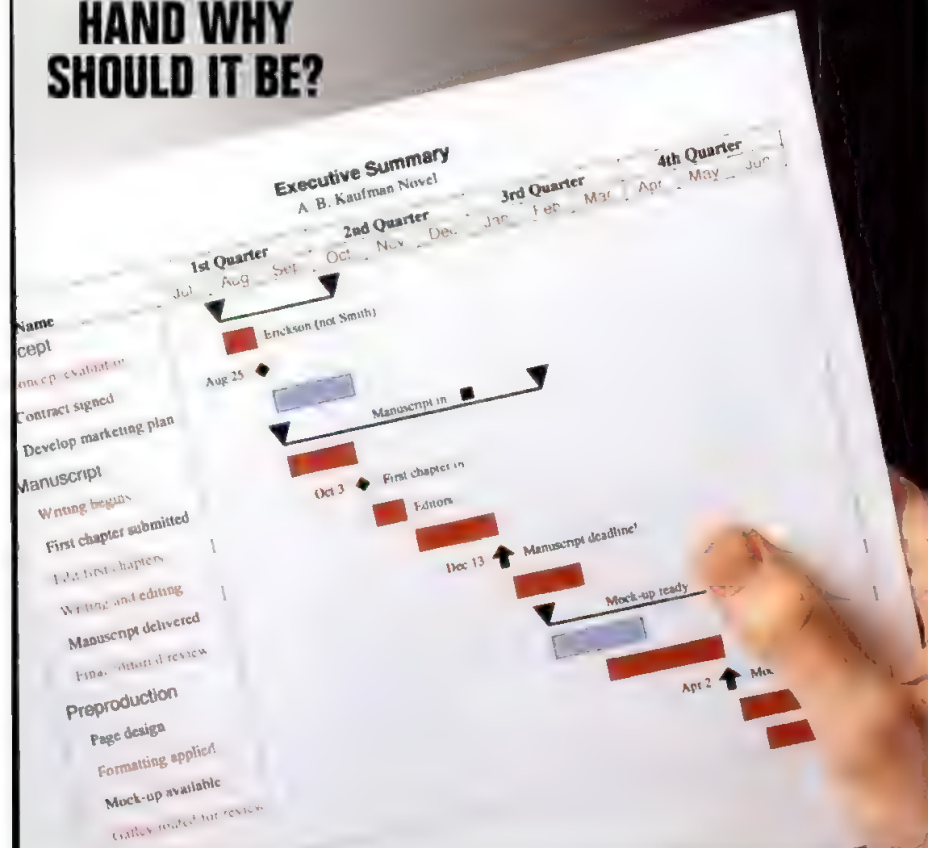
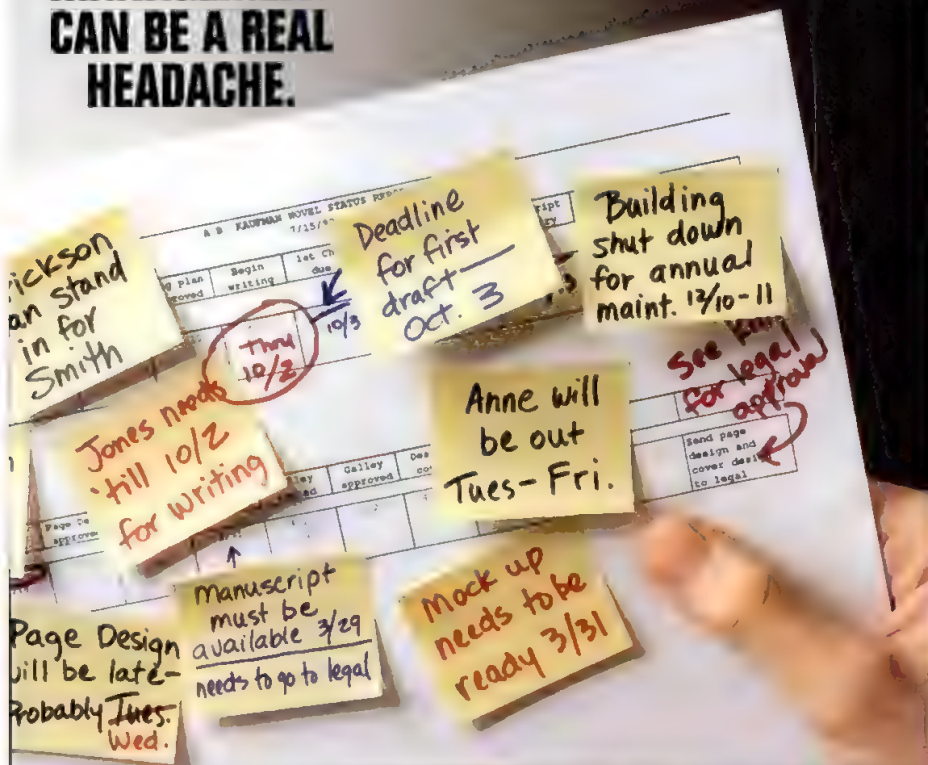
Optquest 2000D

List price: \$649

538 ON READER SERVICE CARD

In short: The Optquest 2000D resembles the ADI MicroScan 4A in all but price (about \$600 on the street for the Optquest and \$520 for the ADI) and warranty (one year for the Optquest versus two years for the ADI). It is a worthwhile, if not exactly the most exciting, 15-inch option.

ON THE OTHER HAND WHY SHOULD IT BE?



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You can even exchange files between Project on your PC and your Mac.* Either way, why not plan on the leading project management software? Microsoft Project 3.0 – it takes the pain out of planning.

Microsoft
Making it easier

14- and 15-Inch Monitors

refresh rate and a maximum noninterlaced resolution of 1,024-by-768 at 70 Hz. The unit supports autosensing for specific video modes.

Superspot test results were solid. The MagnaScan/14 turned in a very bright picture with the second-highest lumi-



nance scores among the monitors we tested in 640-by-480 mode.

In hands-on testing, we pushed the monitor to its 1,024-by-768 limit, when it began to protest, displaying considerable roping at the edges of the screen's image. The monitor's picture cleared up in 800-by-600 mode at 72 Hz, but minor moire patterns kept this unit from vying with the top contenders.

The unique audio capabilities of the MagnaScan/14 won't impress stereo-philos, but the sound is a welcome improvement over that of most PCs. Those interested can find the MagnaScan/14 available for about \$449 in retail outlets.

Relisys

Relisys RE-1458

Relisys RE-1558

BY JOHN R. QUAIN

These two 14- and 15-inch offerings from Relisys didn't distinguish themselves from the rest of the pack. The 14-inch \$815 RE-1458 and 15-inch \$845 RE-1558 have respectable retail prices, around \$345 and \$445 respectively, but performance was only adequate.

Both feature a 0.28-mm dot pitch tube with a top resolution of 1,024-by-768 at 70 Hz. Both can reach 72 Hz in Super VGA and VGA modes. The RE-1458,

Monitors: The Facts on File

CONTINUES

Optique Inc. (continued)

Optique 2000DX

List price: \$649.

539 ON READER SERVICE CARD

In short: Like the AcerView 56L, the FORA Addonics C152/LR, and the ViewSonic 6FS it resembles, the Optique 2000DX makes a more-than-acceptable choice for Windows users.

Packard Bell Electronics

9425 Canoga Ave., Chatsworth, CA 91311; 800-733-4411, 818-886-9998; fax, 818-773-9558

Packard Bell PB8548SVGL

Est. street price: \$399.95.

540 ON READER SERVICE CARD

In short: Available for around \$350-\$400, Packard Bell's 14-inch PB8548SVGL delivers satisfactory but not top-notch performance.

Philips Consumer Electronics Co.

One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 615-475-8869

Magnavox MagnaScan/14

Model CM9214

List price: \$549.

541 ON READER SERVICE CARD

In short: The average display of Philips' Magnavox MagnaScan/14 gets a multimedia boost with a built-in stereo amplifier, two internal speakers, and a headphone jack.

Qume Peripherals Inc.

260 S. Milpitas Blvd., Milpitas, CA 95035; 800-457-4447, 408-942-4242; fax, 408-942-4200

Qume QM857

List price: \$565.

542 ON READER SERVICE CARD

In short: The \$565 14-inch Qume QM857 shares all the virtues of the \$579 AOC CMLB-337 that it closely resembles, and the differences—such as lower pincushion distortion—weren't visible in subjective testing.

Relisys

320 S. Milpitas Blvd., Milpitas, CA 95035; 408-945-9000; fax, 408-945-0587

Relisys RE-1458

List price: \$815.

543 ON READER SERVICE CARD

In short: An unimpressive performer with standard features, the 14-inch Relisys RE-1458 doesn't stand out in this crowd.

Relisys RE-1558

List price: \$845.

544 ON READER SERVICE CARD

In short: The Relisys RE-1558, with a 15-inch flat square tube, is the higher-end companion to the 14-inch Relisys RE-1458, but there's little to distinguish it from the rest of the 15-inch pack.

Sampo America

5550 Peachtree Industrial Blvd., Norcross, GA 30071; 404-449-6220; fax, 404-447-1109

Sampo AlphaScan Plus

List price: \$695.

545 ON READER SERVICE CARD

In short: The Sampo AlphaScan Plus has all the virtues of the Dell UltraScan 14C and the FORA Addonics C141—little wonder, since Sampo manufactures all three units. Like the other two, it has some problems with moire patterns but is otherwise worth a look.

Sampo AlphaScan 15

List price: \$795.

546 ON READER SERVICE CARD

In short: Sampo builds the Sampo AlphaScan 15, as well as the identical Dell UltraScan 15FS and the Taxan MultiVision 550. The AlphaScan 15 had problems in subjective testing that did not surface with the Dell unit (particularly with maintaining image sizes), but it otherwise proves an acceptable choice.

Samtron Displays Inc.

14251 E. Firestone Blvd., Suite 101, La Mirada, CA 92649; 310-802-8425; fax, 310-802-8820

Samtron SC-428TX

List price: \$599.

547 ON READER SERVICE CARD

In short: Samtron Displays' 14-inch analog SC-428TX has a high list price (\$599) but a reasonable street price (\$375). It offers good image-size control but a bit of glare.

Seiko Instruments USA Inc.

1130 Ringwood Court Ave., San Jose, CA 95131; 800-888-0817, 408-922-5800; fax, 408-922-5835

Seiko CM1450

List price: \$599.

548 ON READER SERVICE CARD

In short: Seiko Instruments USA's 14-inch CM1450 is unusual in that it is based on a Trinitron tube. Though the \$440 street price is not the cheapest we saw, the Seiko CM1450 offers structural and display quality that are noteworthy.

Sony Corp. of America, Computer Peripheral Products Co.

655 River Oaks Pkwy., San Jose, CA 95134-1947; 800-352-7669, 408-432-0190; fax, 408-943-0740.

Sony CPD-1304S

List price: \$1,029.95

549 ON READER SERVICE CARD

In short: One of the more impressive entries in the 14-inch class, the Sony CPD-1304S still holds its own against the competition—but at a considerably high price.

Sunshine 99 Inc.

18519 East Gate Ave., City of Industry, CA 91748; 818-854-5590; fax, 818-854-5594

Sunshine CM8+

List price: \$449.

550 ON READER SERVICE CARD

In short: Sunshine 99's 14-inch Sunshine CM8+ matches its low price (\$270 on the street) with low performance. You're probably better off spending a little more for better performance in a 14-inch design.

OS/2

A GREAT PLACE TO WORK

**THE OS/2 WORKPLACE SHELL LETS YOU WORK
THE WAY YOU WANT TO.**

With objects, folders, templates and drag-and-drop actions, the OS/2 Workplace Shell offers a friendly, intuitive applications environment that's truly object-oriented. It's fun, straightforward, easy to use and works in the same way you do. There's none of the confusing techno-speak that comes with other operating systems. In short, there is almost no learning required and the environment can be as simple or sophisticated as you want.

1

THE WORKPLACE SHELL PROVIDES A STRONG FOUNDATION FOR YOUR APPLICATIONS

After installing OS/2, the Workplace Shell appears with a predetermined selection of tools and folders that will help to familiarize the OS/2 novice with the system's capabilities. For instance, the Drives object offers a fast path to file manipulation, and the Productivity Folder contains a selection of information management and time management tools.

But these are only the beginning. OS/2 has no menu bar, so you have a wide-open space on which to install the objects that you create and applications that you need. And the ability to place folders within folders—on a virtually infinite basis—lets you sort and arrange objects exactly the way you want to. As a result, the Workplace Shell has the ability to be as comprehensive or as simple as the situation requires.

OS/2 menus also provide a coherent context, offering only the commands that are available from that point in the interface. This gives you a clear idea of the various choices available in each situation, and doesn't bog you down with irrelevant commands.

2 OS/2'S OBJECTS ECHO COMMON DESKTOP METAPHORS

Under OS/2, a Desktop object falls into one of four categories:

File. OS/2 further develops the traditional file-as-data-receptacle metaphor.



Files hold data and are tied to applications. So a "Memo" created in DeScribe sits on

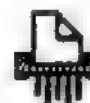
Config.sys the Desktop, where clicking on the icon loads the file and the application in one step.

Program. This includes standard application programs, utilities and tools. A program object, independent of a



file, is positioned on the Desktop for easy access. **Window Washer** and in many cases controls system functions.

Device. A device qualifies as any peripheral that connects OS/2 with the



outside world: printer,

FAX, modem, network or

disk drive all appear as Desk-

Shredder top objects. The Shredder—essentially the OS/2 delete command—is also represented in the same way.

Activating a device object is simple and straightforward: You highlight the file and drag it over to the device to execute the command. Where appropriate, a dialog box appears to confirm the command.

Folder. The OS/2 folder acts like its analog counterpart, containing several different parts that all relate to the same subject. It may contain a combination of files, programs and devices, all pertaining to a single task or project. You can also install a folder within a folder (or an object within a folder) to build a hierarchical series of objects.



Games

4 OS/2 TEMPLATES SET THE STAGE FOR CUSTOMIZED DATA ENTRY

The OS/2 Templates folder, installed with the Workplace Shell, allows you to instantly create objects on the Desktop. Any item in the OS/2 Templates folder can be highlighted, dragged to another location, and opened as a custom file, where it becomes the appropriate database, spreadsheet or document for data entry.

In addition, many OS/2 applications place a custom template into this folder during installation. For instance, to create a memo you may highlight the DeScribe Template and drag it to the Desktop or into a new folder. Then, Alt-single click on the title and modify it accordingly. It's much like a pad of paper, where you tear off one sheet at a time. Under OS/2, each sheet of "paper" harnesses all the full power of the operating system. So instead of a pad of paper you can have a pad of spreadsheets.

5 OS/2 HAS STYLE

It's easy to personalize OS/2's interface to reflect your own taste and style. The primary tools to do so—tools controlling color and fonts—are in the System Setup folder within the OS/2 System group... just four mouse clicks away from the Workplace Shell's opening screen. Here you give each window, folder and object its own color and font scheme and bring a new level of personality to the Desktop.

With the Color Palette, you select the desired hue with a single right-button click, at which point the cursor changes into a paint roller dripping with that shade. You drag the cursor to the destination—a window, menu or Desktop—and release. The color changes instantly. Similarly, to modify

6 THE WORKPLACE SHELL IS A GREAT ORGANIZER

The Workplace Shell is more than a digital desktop from which you launch computer applications. The most significant difference between Workplace Shell, the touchstone of OS/2, and the controlling interfaces of other operating systems, is that it is can be completely customized to fit individual needs. There are no fixed objects in the Workplace Shell. You can easily add or delete any system or program function and include as many or as few commands on the Desktop as you wish. Some people like their desk messy, others like their desk clean.

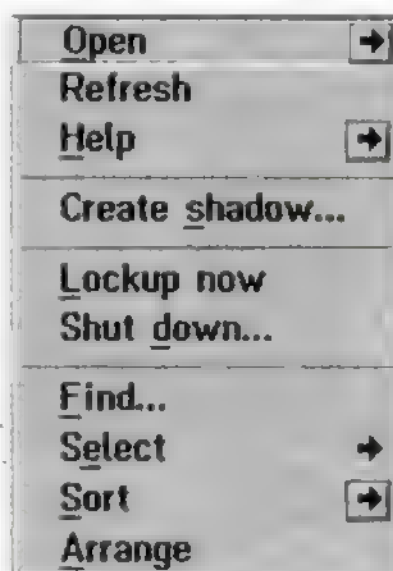
Furthermore, almost all aspects—fonts, colors and icon arrangement—are easily user-modified, with minimal reference to documentation. In most cases, modifications to the OS/2 environment only require a simple drag-and-drop command.

More significantly, the Workplace Shell is completely object oriented—each Desktop object offering a direct path to a file, program, device or folder. This brings a real-world metaphor to the computer Desktop, as everything within OS/2 has a frame of reference to the "real world."

And like your own desk, access to the contents of the object is immediate. You don't need to issue commands to load a program or open a file in order to access the object's contents. This imitates the way you work. You don't need, for instance, to click "Alt-File-Open-Budget" to open a paper folder with a spreadsheet inside.

3 POP-UP MENUS GIVE USERS CLEAR CHOICES

Pop-up menus show exactly what you can do at any given time. Clicking the right mouse button anywhere on the Desktop opens a pop-up menu, which controls the most important Workplace Shell functions. Besides the ability to arrange and sort all Desktop objects, this menu controls password lockup and shutdown. Like other OS/2 menus, this feature shows only the choices that are available from that point in the interface.



the font on any menu or window, you highlight a type style on the Font Palette and drag it to the target.

The Scheme Palette allows you to customize colors and fonts for individual windows, or across the system, in one action. The Color Palette and Font Palette actions only affect the target windows, or you can hold the Alt key to make the modification work universally.

The Minimized Window Viewer offers an icon view of all open applications. You can also get a task list with a simultaneous left/right mouse click anywhere on the Desktop.

The upper left-hand corner of every window contains the program icon for the active application. This gives each OS/2 window an individual nature and offers an immediate visual clue about the window.

Hide, Minimize and Maximize commands are part of every OS/2 window. A single click on the small square hides the application but keeps it active. A single click on the large rectangle switches between full screen and window size.



The shading on a Workplace Shell object indicates that the application is currently active. A double-click motion accesses the open copy of the object directly.

OS/2 allows objects and folders to nest within other folders. As you progress from one folder to another, each is automatically cascaded on the Workplace Shell surface.

OS/2 menus provide all the choices available for a particular object, along with the context. Here, the menu commands control the area within the dotted line.

When a device object is represented anywhere on the Desktop, you can drag-and-drop another object to execute a function. Dragging a file over the shredder object would delete that file.

THE OS/2 MOUSE IS AN ARTFUL DRAG-AND-DROP TOOL

OS/2 relies on the right mouse button to complete drag-and-drop commands, allowing you to control objects in an intuitive way. You highlight a file or an object with a single right-button click, hold the button down and pull it to the desired location—inside another folder, to a device, or onto the Desktop. Releasing the button executes the function.

Drag-and-drop isn't restricted to a single item. If you highlight a file or object with the left mouse button and drag it across another file or object, this highlights both items and allows you to execute a single function like print or shred.

Mouse/key combinations also help to execute the drag-and-drop functions. Ctrl-right mouse button makes a copy of any file or object, which can be moved to any folder.





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CIRCLE 024 ON READER SERVICE CARD

14- and 15-Inch Monitors

which has an actual display area of 13.4 inches, uses a conventional spherical tube with a silica-coated etched screen to fight glare and fend off dust accumulation. The RE-1558, with a 14.2-inch visible diagonal display area, is founded on a flatter, etched, flat square CRT. Both monitors use mode-based autosensing.

The standard array of analog image size and position controls are offered on both models, but the RE-1558's are on the front while the RE-1458's are rather awkwardly concealed behind a panel on the right-hand side of the monitor. Neither model allows you to completely overscan images, so in some graphics modes you'll lose about half an inch horizontally overall.

In Superspot testing, the RE-1458 suffered the highest Maximum Vertical Misconvergence of the monitors we tested, though the other tests went smoothly. In subjective evaluations, the RE-1458's superior image brightness was apparent, but so was the misconvergence.

VGA Superspot testing on the RE-1558 showed its Maximum Vertical Misconvergence to be better than that of the RE-1458 (though it was still higher than it should be), but its Maximum Horizontal Misconvergence was not quite as good as that of its smaller sibling. The amount of pincushion error was also a little higher than we would liked to have seen. In SVGA, sharpness dropped off to below average; also, Maximum Horizontal Convergence and Vertical Pincushioning test scores were higher than they were with most of the other 15-inch models we tested.

On subjective tests, the RE-1558 performed well in SVGA mode, with better-than-average transient response account-

Monitors: The Facts on File

ENDS

Sunshine 99 Inc. (continued)

Sunshine CM15C

List price: \$695.

551 ON READER SERVICE CARD

In short: A better performer than its smaller brandmate, the 15-inch Sunshine CM15C still can't match the top-tier crowd. The savings you'll get with its good street price may not be significant enough to recommend this over slightly higher-priced—and higher-performance—15-inch monitors.

Taxan America Inc.

2880 San Tomas Expwy., Suite 101, Santa Clara, CA 95051; 800-648-2926, 408-748-0900;

fax, 408-748-9599

Taxan MultiVision 550

List price: \$799.

Tilt swivel base \$19.95

552 ON READER SERVICE CARD

In short: Like the Sampo AlphaScan 15 that it resembles, the Taxan MultiVision 550 had some problems maintaining image sizes across modes and reacted more severely to regulation testing than the Dell UltraScan 15FS. But in other respects, it is a decent, if not overly enticing, choice.

TVM Professional Monitor Corp.

4260 E. Brickell, Ontario, CA 91761; 909-988-3368; fax, 909-986-3188

TVM MediaScan 4A+

List price: \$455

553 ON READER SERVICE CARD

In short: The TVM MediaScan 4A+ costs a little more than the identical FORA Addonics C143 and Optique 1000S. The main extra you get for the higher cost is a two-year warranty, which compares with one-year warranties with the other two.

TVM LowRadiation 5A+

List price: \$647.

554 ON READER SERVICE CARD

In short: A microprocessor, digital controls, a flat square screen, and a 72-Hz vertical refresh rate in 1,024-by-768 mode are all big pluses here. If you can find it at a better bargain than \$599 (its maximum estimated street price) it's worth investigating.

ViewSonic

20480 Business Pkwy., Walnut, CA 91789; 800-888-8583, 909-869-7976; fax, 909-869-7958

ViewSonic 5E

List price: \$599

555 ON READER SERVICE CARD

In short: The 14-inch analog ViewSonic 5E is one step up from low end, with a spherical section screen and a maximum noninterlaced resolution of 1,024-by-768 at 72 Hz. But for about the same price, other 14-inch monitors offer digital controls and digital memory.

ViewSonic 6

List price: \$499

556 ON READER SERVICE CARD

In short: The ViewSonic 6 is a low-end 14-inch monitor with analog controls (but not a vertical-position control), a spherical section screen, and a maximum noninterlaced resolution of 1,024-by-768 at 60 Hz. But its low street price is not much less than the cost of some digital 14-inch monitors.

ViewSonic 6FS

List price: \$699

557 ON READER SERVICE CARD

In short: Like the AcerView 56L, the FORA Addonics C152/LR, and the Optique 2000DX that it resembles, the ViewSonic 6FS offers a plethora of features and a good street price that will make it attractive to Windows users.

WEN Technology Corp.

11 Clearbrook Rd., Elmsford, NY 10523; 800-377-4936, 914-347-4100; fax, 914-347-4128

WEN JK1466 Color Monitor

List price: \$440.

558 ON READER SERVICE CARD

In short: With a relatively low street price of \$350, the WEN JK1466 is a satisfactory performer, but it's not without some flaws (such as its lack of a horizontal control).

ing for a clear picture. In fine-grained line resolution tests, it was moire resistant. However, the pincushioning detected by

the Superspot was noticeable along the vertical edges, but not too distracting.

Overall, both generated a lukewarm impression. If you can find substantial discounts, ask for compliance with the low-emission standard MPR II, offered as a \$20 option on both monitors.

Samtron Displays Inc.

Samtron SC-428TX

BY BRUCE BROWN

The Samtron SC-428TX is a 14-inch analog monitor with a rather high list price (\$599) but a much more palatable street price (\$375).

Made by Samsung Electron Devices of Korea, the SC-428TX has a 0.28-mm dot pitch, a spherical CRT with a conventional shadow mask, and a visible diagonal screen size of 13.2 inches. The maximum noninterlaced resolution is 1,024-by-768 with a vertical refresh rate of 60



The Relisys RE-1458 and Relisys RE-1558

14- and 15-Inch Monitors



Hz. It has a 72-Hz refresh rate in both 800-by-600 and 640-by-480 modes. It lacks autosizing or mode sensing, but needs only small adjustments when switching resolutions or frequencies.

The fixed-frequency unit had some of the best VGA Vertical and Horizontal Pincushioning test scores (0.141 and 0.122, respectively). Subjective tests showed minimal muddiness between tight text and just a little moire patterning. But there was some image pulsing in regulation testing and two small bounces during the switch from text to graphics mode. The dark-tinted glass allows quite a bit of glare and reflection, so you might want to consider a filter.

Samtron sells three other 14-inch models: the \$399 VGA SC-441V, the \$499 SC-431VS (a 1,024-by-768 interlaced display with a 0.31-mm dot pitch), and the \$529 SC-428VS (a 1,024-by-768 interlaced monitor with a 0.28-mm dot pitch). But the SC-428TX is the top of the line.

Seiko Instruments USA Inc.

Seiko CM1450

BY BRUCE BROWN

Seiko Instruments USA's CM1450 is a high-quality 14-inch Trinitron tube monitor that lists for \$599, but it more commonly sells for about \$440. Although this roundup also includes 14-inch models

that cost more than \$100 less, the CM1450 offers overall structural and display quality that are noteworthy.

The curved-screen Seiko has a 0.25-mm grill pitch (tighter than average for this roundup), but, like most of the 14-inch models, features analog controls. The maximum noninterlaced resolution of this variable frequency unit is 1,024-by-768; in this mode, it supports a 60-Hz vertical refresh rate. Both 800-by-600 and 640-by-480 modes will run at up to 72 Hz.

The visible display area measures 13.2 inches from bezel to bezel. The screen has a highly effective silica coating that allows only minimal glare and reflection.

The CM1450 tested well on both Superspot and subjective testing. The Maximum Vertical Misconvergence score was a little high, but blooming was not noticeable to the naked eye. We observed only minimal muddiness and moire patterning, along with a little

image pulsing during regulation testing. The monitor's admirable Average MTF scores were matched by a high degree of sharpness in subjective viewing. About the only real display problem was significant bouncing when switching between modes. And since

this monitor doesn't automatically size images on resolution or frequency changes, you'll have to readjust the image size manually with each switch.

For DOS or Windows users who don't change video resolutions frequently, the Seiko is a fine unit.

Sony Corp. of America,
Computer Peripheral Products Co.

Sony CPD-1304S

BY JOHN R. QUAIN

With a big reputation can come a big list price: \$1,029.95, in this case. But don't let that prevent you from considering this solid performer, available through dealers for a more reasonable, though certainly not modest, \$580.

The 14-inch Sony CPD-1304S is based on Sony's characteristic vertically flat Trinitron tube. Its 0.25-mm aperture grill and etched and silica-coated screen produce flatter-than-average images. The diagonal viewing area is 13.3 inches. This unit is capable of VGA and Super VGA modes at 72 Hz and a top noninterlaced resolution of 1,024-by-768 at 70 Hz. Brightness and contrast dials are up



front, but positioning and size analog controls are clumsily placed on the left side of the unit.

Superspot VGA testing was consistently smooth, with remarkably low Maximum Horizontal Misconvergence scores. In subjective testing, we found Sony's reputation to be well-deserved. In VGA mode under Windows, it had excellent brightness, clarity, and image uniformity.

Sony monitors can be an acquired taste. The vertically slotted Trinitron shadow mask can make vertical lines seem brighter than horizontal lines.

Except for some pincushion distortion in SVGA mode, due partly to the narrower 60-MHz video bandwidth, we found it impressive.

Sunshine 99 Inc.

Sunshine CM8+

Sunshine CM15C

BY BRUCE BROWN

The \$449 14-inch Sunshine CM8+ and the \$695 15-inch Sunshine CM15C have very low street prices, but don't look for top-level performance.

Both analog monitors have 0.28-mm dot pitch shadow-mask tubes and dark-

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► SUMMARY OF FEATURES

14- and 15-Inch Monitors

In alphabetical order by company



■ = YES □ = NO

	Aamazing CM8428MX	Aamazing CM1528FS	AcerView 56L	ADI MicroScan 3E	ADI MicroScan 3E+	ADI MicroScan 4A
List price	\$499.00	\$699.00	\$899.00	\$649.00	\$749.00	\$859.00
Tube size (diagonally, in inches)	14	15	15	14	14	15
Visible screen size (inches)	13.3	13.6	13.5	13.8	13.5	13.5
Dimensions (HWD, in inches)	14 x 14.5 x 15.5	14.3 x 14.3 x 15	14 x 14 x 15	15 x 15 x 14	15 x 15 x 14	15 x 15 x 15
Weight (pounds)	27.6	27.1	35.0	28.0	28.0	30.0
Length of power cable (inches)	72	72	72	72	72	72
Adapter cable included	Captive to miniDB-15	MiniDB-15 to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15
FCC certification class	B	B	B	B	B	B
Signal Compatibility						
1,280 x 1,024	□	■	□	■	■	■
1,024 x 768 noninterlaced	■	■	■	■	■	■
1,024 x 768 interlaced	■	■	■	■	■	■
Super VGA (800 x 600)	■	■	■	■	■	■
VGA (640 x 480)	■	■	■	■	■	■
MCGA/Hercules	■ □	■ □	■ □	■ □	■ □	■ □
Mac II/Apple II GS	□ □	□ □	■ □	□ □	□ □	□ □
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Variable	Variable	Variable
Maximum noninterlaced resolution (pixels)	1,024 x 768	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Video bandwidth (MHz)	65	85	80	65	75	75
Vertical scanning frequency (Hz)	50-90	47-104	50-90	50-100	50-100	50-100
Horizontal scanning frequency (kHz)	32-48	28-64	31-60	30-50	30-58	30-58
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	N/A	72	N/A	87	87	87
1,024 x 768 noninterlaced	60	74	72	60	72	72
Super VGA (800 x 600)	72	74	72	72	72	72
VGA (640 x 480)	72	74	84	72	72	72
Phosphor persistence	Medium-short	Medium-short	Medium	Medium-short	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.28
Analog or digital controls	Analog	Analog	Digital	Digital	Digital	Digital
Power consumption (watts)	90	132	110	85	85	90
Microprocessor included	□	□	■	■	■	■
Number of simultaneously stored settings	N/A	N/A	32	9	10	10
Number of user-definable settings	N/A	N/A	32	9	10	10
Controls						
Brightness/Contrast	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Color matching	□	□	□	□	□	□
Horizontal/vertical position	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Horizontal/vertical size	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Pincushioning/Barrel distortion	□ □	□ □	■ ■	■ ■	■ ■	■ ■
Degaussing	□	□	□	□	□	□
120-/240-volt switching	□	□	□	□	□	□
VLF/ELF radiation control	□ □	□ □	■ ■	□ □	□ □	□ □
Customer Service						
Toll-free technical support	■	■	■	■	■	■
Telephone technical support hours (eastern time)	11:00-8:00 M-F	11:00-8:00 M-F	10:00 A.M.-10:00 P.M. Mon.-Sat.	11:30-8:30 M-F	11:30-8:30 M-F	11:30-8:30 M-F
24-hour BBS	□	□	■	□	□	□
Warranty	1 year	1 year	1 year	2 years	2 years	2 years

N/A—Not applicable: The product does not have this feature

COVER STORY
14- and 15-Inch Monitors

CONTINUES

CMLB-337	AOC CM-536	Arche 214MH VGA Monitor	Compaq 1024 Color Monitor	Compaq QVision 150	CTX CMS-1461	Darius HRN-1424	Dell UltraScan 14C	Dell UltraScan 14LR
\$579.00	\$699.00	\$599.00	\$441.00	\$793.00	\$579.00	\$699.00	\$449.00	\$519.00
14	15	14	14	15	14	14	14	14
13.8	14	13.5	13.8	13.4	13.2	13	13.2	13.2
11 x 14 x 15	14.5 x 14.5 x 15	15 x 14 x 14	15 x 15 x 14	16 x 16 x 17	16 x 14.3 x 15	14 x 13.5 x 12.3	15 x 14 x 14.5	13.9 x 13.7 x 15.2
27.2	31.9	25.4	28.0	45.0	22.0	24.8	27.3	26.0
60	60	72	60	80	60	72	72	60
Captive to DB-15	Captive to DB-15	MiniDB-15 to miniDB-15	Captive to miniDB-15	BNC-5 to miniDB-15	Captive to DB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to DB-15
B	B	B	B	B	B	B	B	B

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Variable	Variable	Fixed	Variable	Variable	Variable	Variable	Variable	Variable
1,024 x 768	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
80	100	65	75	75	85	50	80	70
50-90	50-90	45-100	50-100	50-100	50-90	47-100	50-90	50-90
30-60	30-68	32-49	30-58	32-58	30-60	31-60	30-60	30-58
N/A	60	N/A	N/A	N/A	87	N/A	N/A	N/A
72	72	60	72	72	70	70	72	72
72	72	72	72	72	72	72	72	72
72	72	72	75	75	72	72	72	73
Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
0.28	0.28	0.28	0.28	0.26	0.28	0.28	0.28	0.28
Analog	Digital	Analog	Digital	Digital	Analog	Analog	Analog	Digital
80	110	90	85	175	80	75	110	90
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N/A	36	N/A	10	14	N/A	N/A	N/A	12
N/A	36	N/A	10	6	N/A	N/A	N/A	6

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8:30 M-F	11:30-8:30 M-F	10:30-7:30 M-F	7:00-7:00 M-F	7:00-7:00 M-F	11:30-8:00 M-F	11:00-8:00 M-F	8:00 A.M.-2:00 A.M. Sun.-Sat.	8:00 A.M.-2:00 A.M. Sun.-Sat.
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1 year	1 year	1 year	1 year	1 year	2 years	2 years	1 year	1 year

► SUMMARY OF FEATURES

In alphabetical order by company

■ = YES □ = NO

	Dell UltraScan 15FS	Dell UltraScan 15LR	FORA Addonics C141	FORA Addonics C143	FORA Addonics C152/LR	Hitachi/ Nissei SuperScan 15
List price	\$549.00	\$639.00	\$449.00	\$399.00	\$599.00	\$795.00
Tube size (diagonally, in inches)	15	15	14	14	15	15
Visible screen size (inches)	14	13.7	13.2	13.2	13.5	13.7
Dimensions (HWD, in inches)	15 x 14 x 15	15.5 x 14.5 x 16.5	15 x 14 x 14.5	13.4 x 14 x 15	14 x 14 x 15	15 x 14 x 16
Weight (pounds)	35.0	40.2	27.3	24.2	35.0	37.8
Length of power cable (inches)	72	72	72	60	60	72
Adapter cable included	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to DB-15
FCC certification class	B	B	B	B	B	B
Signal Compatibility						
1,280 x 1,024	□	□	□	□	□	□
1,024 x 768 noninterlaced	■	■	■	■	■	■
1,024 x 768 interlaced	■	■	■	■	■	■
Super VGA (800 x 600)	■	■	■	■	■	■
VGA (640 x 480)	■	■	■	■	■	■
MCGA/Hercules	■ □	■ □	■ □	□ □	■ □	□ □
Mac II/Apple II GS	□ □	□ □	□ □	□ □	■ □	■ □
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Fixed	Variable	Variable
Maximum noninterlaced resolution (pixels)	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Video bandwidth (MHz)	80	75	80	65	80	75
Vertical scanning frequency (Hz)	50-90	55-90	50-90	47-100	50-90	50-100
Horizontal scanning frequency (kHz)	30-60	32-57	30-60	32-48	31-60	30-58
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	N/A	N/A	N/A	N/A	N/A	N/A
1,024 x 768 noninterlaced	72	70	72	60	72	72
Super VGA (800 x 600)	72	72	72	72	72	72
VGA (640 x 480)	72	72	72	72	84	72
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium-short	Medium	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.28
Analog or digital controls	Analog	Analog	Analog	Analog	Digital	Analog
Power consumption (watts)	120	120	110	100	110	110
Microprocessor included	□	□	□	□	■	□
Number of simultaneously stored settings	N/A	N/A	N/A	N/A	32	N/A
Number of user-definable settings	N/A	N/A	N/A	N/A	32	N/A
Controls						
Brightness/Contrast	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Color matching	□	□	□	□	□	□
Horizontal/vertical position	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Horizontal/vertical size	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Pincushioning/Barrel distortion	□ □	■ □	□ □	□ □	■ ■	□ □
Degaussing	□	■	□	□	□	□
120-/240-volt switching	□	□	□	■	□	□
VLF/ELF radiation control	□ □	■ ■	□ □	□ □	■ ■	■ ■
Customer Service						
Toll-free technical support	■	■	□	□	□	■
Telephone technical support hours (eastern time)	8:00 A.M.-2:00 A.M. Sun.-Sat.	8:00 A.M.-2:00 A.M. Sun.-Sat.	8:00 A.M.-2:00 A.M. M-F	11:00-9:00 M-F	11:00-9:00 M-F	9:00-5:00 M-F
24-hour BBS	■	■	□	□	□	□
Warranty	1 year	1 year	1 year	1 year	1 year	2 years

N/A—Not applicable. The product does not have this feature.

14- and 15-Inch Monitors

CONTINUES



HP Value-Point 6312 Color Display	IBM PS/Value-Point 6314 Color Display	IBM PS/Value-Point 6319 Color Display	IOcomm ThinkSync 4E	IOcomm ThinkSync 5	MAG LX1460	MAG MX14S	MAG MX15F	Mitsuba 710VX
\$405.00	\$530.00	\$660.00	\$495.00	\$795.00	\$449.00	\$799.00	\$899.00	\$469.00
14	14	15	14	15	14	14	15	14
13	13.2	13.6	13.5	14	13.5	13	13.8	13
1 x 14 x 15	15 x 14 x 16	16 x 15 x 16	14.3 x 14.5 x 14.8	14.3 x 14.5 x 15	14 x 14 x 15	14.3 x 14 x 16	14 x 14 x 16.5	14 x 14 x 14
24.0	33.0	34.0	26.2	31.0	26.5	34.0	35.9	27.3
73	73	73	72	72	60	60	60	70
Captive to miniDB-15	miniDB-15 to miniDB-15	miniDB-15 to miniDB-15	Captive to miniDB-15	Mini DB-15 to miniDB-15	Captive to miniDB-15	Captive to DB-15	Captive to DB-15	Captive to miniDB-15
B	B	B	B	A	B	B	B	B
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Variable	Variable	Variable	Variable	Variable	Variable	Variable	Variable	Variable
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024	1,024 x 768
75	85	85	65	100	80	100	100	65
47-100	50-120	50-120	50-90	40-100	50-100	50-120	50-120	56-87
31-50	30-60	30-60	32-48	30-65	30-60	30-64	30-68	32-48
N/A	N/A	N/A	88	60	87	60	60	N/A
60	72	72	60	76	72	76	76	60
72	72	72	72	76	85	76	76	72
75	75	75	72	72	85	76	76	72
Short	Short	Short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
0.28	0.28	0.28	0.28	0.28	0.28	0.25	0.28	0.28
Analog	Digital	Digital	Analog	Analog	Analog	Digital	Digital	Analog
85	80	80	89	110	110	110	110	90
☐	☒	☒	☐	☐	☐	☒	☒	☐
N/A	13	13	N/A	N/A	N/A	17	17	N/A
N/A	13	13	N/A	N/A	N/A	8	8	N/A
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24 hours	24 hours	24 hours	11:30-8:30 M-F	11:30-8:30 M-F	11:30-8:00 M-F	11:30-8:00 M-F	11:30-8:00 M-F	11:30-8:30 M-F
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1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year

14- and 15-Inch Monitors

► SUMMARY OF FEATURES

In alphabetical order by company						
■ = YES □ = NO	Mitsubishi Diamond Pro 14	PC EDITOR'S CHOICE Nanao Flexscan F340iW	NEC MultiSync 3FGX	PC EDITOR'S CHOICE NEC MultiSync 4FG	Neotec NT-1456	Optquest 1000S
List price	\$699.00	\$899.00	\$635.00 (estimated)	\$759.00 (estimated)	\$365.00	\$409.00
Tube size (diagonally, in inches)	14	15	15	15	14	14
Visible screen size (inches)	13.2	13.8	13.8	13.8	13.4	13.2
Dimensions (HWD, in inches)	13.9 x 13.7 x 15.2	14.9 x 14.4 x 16.2	15.6 x 14.6 x 16.3	15.6 x 14.6 x 16.3	14.3 x 14.3 x 16	14 x 14 x 14
Weight (pounds)	26.5	35.2	36.5	39.2	27.5	24.2
Length of power cable (inches)	60	80	72	72	72	72
Adapter cable included	Captive to miniDB-15	Captive to miniDB-15	Captive to DB-15	Captive to DB-15	Captive to DB-15	Captive to miniDB-15
FCC certification class	B	B	B	B	B	B
Signal Compatibility						
1,280 x 1,024	□	□	□	□	□	□
1,024 x 768 noninterlaced	■	■	■	■	■	■
1,024 x 768 interlaced	■	■	■	■	■	■
Super VGA (800 x 600)	■	■	■	■	■	■
VGA (640 x 480)	■	■	■	■	■	■
MCGA/Hercules	□□	■□	■□	■□	■□	□□
Mac II/Apple II GS	■□	■□	■□	■□	□□	□□
Operational Features						
Fixed or variable frequency	Variable	Variable	Variable	Variable	Variable	Fixed
Maximum noninterlaced resolution (pixels)	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 960	1,024 x 768
Video bandwidth (MHz)	70	75	65	75	75	65
Vertical scanning frequency (Hz)	50-90	55-90	55-90	55-90	50-120	47-100
Horizontal scanning frequency (kHz)	30-58	27-61	32-49	27-57	30-56	32-48
Maximum vertical refresh rates (Hz):						
1,280 x 1,024	N/A	N/A	N/A	N/A	N/A	N/A
1,024 x 768 noninterlaced	72	76	60	70	70	60
Super VGA (800 x 600)	72	90	72	80	72	72
VGA (640 x 480)	73	90	72	90	72	72
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.28
Analog or digital controls	Digital	Digital	Analog	Digital	Analog	Analog
Power consumption (watts)	90	100	100	105	80	100
Microprocessor included	■	■	□	■	□	□
Number of simultaneously stored settings	12	28	N/A	19	N/A	N/A
Number of user-definable settings	6	28	N/A	4	N/A	N/A
Controls						
Brightness/Contrast	■□	■□	■□	■□	■□	■□
Color matching	□	■	□	■	□	□
Horizontal/vertical position	■□	■□	■□	■□	■□	■□
Horizontal/vertical size	■□	■□	■□	■□	■□	■□
Pincushioning/Barrel distortion	■□	■□	■□	■□	□□	□□
Degaussing	□	■	■	■	□	□
120-/240-volt switching	□	□	□	□	□	■
VLF/ELF radiation control	■□	■□	■□	■□	□□	□□
Customer Service						
Toll-free technical support	■	■	■	■	□	■
Telephone technical support hours (eastern time)	11:00-7:30 M-F	11:30-8:00 M-F	8:30-8:00 M-F	8:30-8:00 M-F	11:30-8:30 M-F	8:00-5:00 M-F
24-hour BBS	■	■	■	■	□	□
Warranty	2 years	1 year	2 years on parts, 1 year on labor	2 years on parts, 1 year on labor	1 year	1 year

N/A—Not applicable: The product does not have this feature

14- and 15-Inch Monitors

CONTINUES

EDITORS
CHOICE

Optquest 1500D	Optquest 2000D	Optquest 2000DX	Packard Bell PB8548SVGL	Philips Magnavox MagnaScan/14 Model CM9214	Qume QM857	Relisys RE-1458	Relisys RE-1558	Sampo AlphaScan Plus
\$499.00	\$649.00	\$649.00	\$399.95 (estimated)	\$549.00	\$565.00	\$815.00	\$845.00	\$695.00
14	15	15	14	14	14	14	15	14
13.5	13.5	13.5	13.3	13.2	13.8	13.4	14.2	13.2
15 x 15 x 14	15 x 15 x 15	14 x 14 x 15	12.5 x 14.5 x 15.75	13.8 x 14 x 15.5	13.5 x 14 x 15	13.8 x 15 x 15.3	15.8 x 15 x 16.3	15 x 14 x 14.5
28.0	30.0	35.0	35.0	35.0	35.0	35.0	35.0	27.3
72	72	72	72	78	60	72	72	72
Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to DB-15	Captive to DB-15	Captive to DB-15	Captive to DB-15	Captive to miniDB-15
B	B	B	B	B	B	B	B	B

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☐ ☐	☐ ☐	☒ ☐	☐ ☐	☒ ☐	☒ ☐	☐ ☐	☐ ☐	☐ ☐

Variable	Variable	Variable	Fixed	Variable	Variable	Variable	Variable	Variable
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
75	75	80	65	75	65	75	75	80
50-100	50-100	50-90	50-90	50-100	50-90	50-120	50-120	50-90
30-58	30-58	31-60	32-48	30-58	30-60	30-58	30-58	30-60
87	87	N/A	N/A	N/A	N/A	N/A	N/A	N/A
72	72	72	60	70	72	70	70	72
72	72	72	72	72	72	72	72	72
72	72	84	72	72	72	72	72	72
Medium-short	Medium-short	Medium	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Digital	Digital	Digital	Analog	Analog	Analog	Analog	Analog	Analog
85	90	110	85	85	80	110	110	110
☒	☒	☒	☐	☐	☐	☐	☐	☐
10	10	32	N/A	N/A	N/A	N/A	N/A	N/A
10	10	32	N/A	N/A	N/A	N/A	N/A	N/A

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☐	☐	☐	☒	☐	☐	☒ (auto-sensing)	☒ (auto-sensing)	☐
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8:00-5:00 M-F	8:00-5:00 M-F	8:00-5:00 M-F	24 hours M-F; 11:00-8:00 Sat., Sun.	9:00-5:30 M-F	10:00-8:00 M-F	8:00-5:00 M-F	8:00-5:00 M-F	8:00-5:00 M-F
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1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year

COVER STORY
14- and 15-Inch Monitors

► **S U M M A R Y O F F E A T U R E S**

In alphabetical order by company

■ = YES □ = NO

	Sampo AlphaScan 15	Samtron SC-428TX	Seiko CM1450	Sony CPD-1304S	Sunshine CM8+
List price	\$795.00	\$599.00	\$599.00	\$1,029.95	\$449.00
Tube size (diagonally, in inches)	15	14	14	14	14
Visible screen size (inches)	14	13.2	13.2	13.3	13.2
Dimensions (HWD, in inches)	15 x 14 x 15	14 x 13.5 x 15	13.5 x 13.8 x 14	14 x 13.8 x 16.3	13.8 x 14.3 x 15.5
Weight (pounds)	35.0	35.0	35.0	35.0	35.0
Length of power cable (inches)	72	72	72	60	72
Adapter cable included	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to DB-15	Captive to miniDB-15
FCC certification class	B	B	B	B	B
Signal Compatibility					
1,280 x 1,024	■	□	□	□	□
1,024 x 768 noninterlaced	■	■	■	■	■
1,024 x 768 interlaced	■	■	■	■	■
Super VGA (800 x 600)	■	■	■	■	■
VGA (640 x 480)	■	■	■	■	■
MCGA/Hercules	■ □	■ □	■ □	□ □	□ □
Mac II/Apple II GS	□ □	□ □	□ □	■ □	□ □
Operational Features					
Fixed or variable frequency	Variable	Fixed	Variable	Variable	Variable
Maximum noninterlaced resolution (pixels)	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Video bandwidth (MHz)	80	65	60	60	64
Vertical scanning frequency (Hz)	50-90	50-90	50-90	55-110	50-90
Horizontal scanning frequency (kHz)	30-64	32-48	31-50	28-57	30-48
Maximum vertical refresh rates (Hz):					
1,280 x 1,024	60	N/A	N/A	N/A	N/A
1,024 x 768 noninterlaced	72	60	60	70	60
Super VGA (800 x 600)	72	72	72	72	72
VGA (640 x 480)	72	72	72	72	70
Phosphor persistence	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short
Dot pitch or aperture grill pitch (mm)	0.28	0.28	0.25	0.25	0.28
Analog or digital controls	Analog	Analog	Analog	Analog	Analog
Power consumption (watts)	120	70	150	100	75
Microprocessor included	□	□	□	□	□
Number of simultaneously stored settings	N/A	N/A	N/A	N/A	N/A
Number of user-definable settings	N/A	N/A	N/A	N/A	N/A
Controls					
Brightness/Contrast	■ ■	■ ■	■ ■	■ ■	■ ■
Color matching	□	□	□	□	□
Horizontal/vertical position	■ ■	■ ■	■ ■	■ ■	■ ■
Horizontal/vertical size	■ ■	■ ■	■ ■	■ ■	□ ■
Pincushioning/Barrel distortion	□ □	□ □	□ □	□ □	□ □
Degaussing	□	□	□	□	□
120-/240-volt switching	□	□	□	■ (auto-sensing)	□
VLF/ELF radiation control	□ □	■ ■	□ □	■ ■	Optional
Customer Service					
Toll-free technical support	□	□	■	□	□
Telephone technical support hours (eastern time)	8:00-5:00 M-F	11:30-8:30 M-F	11:00-9:00 M-F	8:00-5:00 M-F	12:00-8:00 M-F
24-hour BBS	□	□	■	■	□
Warranty	1 year	1 year	1 year	1 year	1 year

N/A—Not applicable. The product does not have this feature.

COVER STORY
14- and 15-Inch Monitors

ENDS

	Sunshine CM15C	Taxan MultiVision 550	TVM MediaScan 4A+	TVM LowRadiation 5A+	ViewSonic 5E	ViewSonic 6	ViewSonic 6FS	WEN JK1466 Color Monitor
	\$695.00	\$799.00	\$455.00	\$647.00	\$599.00	\$499.00	\$699.00	\$440.00
	15	15	14	15	14	14	15	14
	13.6	14	13.2	13.5	13.4	13.5	13.5	13.5
	14.5 x 14.8 x 15.5	15 x 14 x 15	15 x 15 x 15	15.3 x 14.5 x 16	14 x 14 x 15	15 x 14 x 15	14 x 14 x 15	14.5 x 14.5 x 14
	35.0	35.0	35.0	35.0	30.8	24.2	35.0	26.7
	72	72	60	72	54	60	60	72
	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15	Captive to miniDB-15
	B	B	B	B	B	B	B	B

	■	□	□	■	□	□	■	□
	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■
	□□	■□	■□	■□	■□	■□	■□	■□
	□□	□□	□□	□□	□□	□□	□□	■□

	Variable	Variable	Fixed	Variable	Variable	Variable	Variable	Variable
	1,280 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
	85	80	65	65	80	65	80	70
	40-90	50-90	47-100	40-100	50-90	50-90	50-90	48-90
	30-64	30-60	32-48	30-57	31-60	30-50	31-60	30-59
	60	N/A	N/A	88	N/A	N/A	87	N/A
	76	70	60	72	72	60	72	72
	72	72	72	72	72	72	72	72
	70	72	72	72	72	72	84	72
	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium-short	Medium	Medium-short
	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
	Analog	Analog	Analog	Digital	Analog	Analog	Digital	Analog
	100	110	100	90	100	85	110	80
	□	□	□	■	□	□	■	□
	N/A	N/A	N/A	15	N/A	N/A	32	N/A
	N/A	N/A	N/A	15	N/A	N/A	32	N/A

	■□	■□	■□	■□	■□	■□	■□	■□
	□	□	□	□	□	□	□	□
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	■	□	□	□	□	□	□	□
	□	□	■	□	■	□	□	■
	Optional	□□	□□	■□	□□	□□	■□	Optional

	□	■	■	■	■	■	■	■
	12:00-8:00 M-F	11:00-8:00 M-F	11:15-8:00 M-F	11:15-8:00 M-F	7:00-5:00 M-F, 8:00-12:00 Sat.	7:00-5:00 M-F, 8:00-12:00 Sat.	7:00-5:00 M-F, 8:00-12:00 Sat.	9:00-6:00 M-F
	□	■	□	□	■	■	■	□
	1 year	2 years	2 years	2 years	1 year	1 year	1 year	1 year

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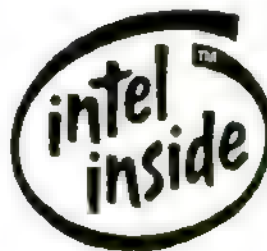


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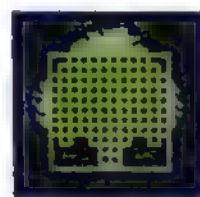
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14- and 15-Inch Monitors



tinted glass that allows little glare in most environments. Both variable-frequency scanning monitors support a refresh rate of 72 Hz in 800-by-600 and 60 Hz in 1,024-by-768 noninterlaced mode and have an attached adapter cable. Low-radiation versions cost \$30 more.

The visible size of the CM8+'s spherical screen is 13.2 inches. It lacks a horizontal-size control, but an Auto/Manual button lets you adjust the screen size or revert to the default for the incoming signal. The adjustments needed when switching modes are minimal.

Superspot and subjective testing revealed a vertical pincushion effect on the right side. The CM8+ also had muddiness between tight text, significant moire patterning, and regulation that was less than rock solid. The screen also turned snowy before clearing after each mode change.

Although the CM8+ is an inexpensive \$270 on the street, its unimpressive performance suggests that you should spend more money if you want to see better performance.

SUNSHINE CM15C

The 15-inch CM15C offers a flat square screen and a higher maximum noninterlaced resolution of 1,280-by-1,024 at 60 Hz, although the 13.6-inch visible diagonal screen size isn't big enough to make that mode very practical.

Superspot testing revealed slightly high Maximum Vertical Misconvergence scores in both modes. Both Super VGA Pincushioning test scores were also higher than average, as was the VGA Horizontal Pincushioning score. No blooming or bowing was noticeable to the naked eye, however. The unit showed sig-

nificant moire patterning in subjective testing and less muddiness with tight text. It also had excellent regulation control.

You must readjust screen size after resolution changes, and this model lacks the Auto/Manual button—although it has a degaussing button.

The CM15C we tested was a noticeably better performer than its sibling. But while the \$480 street price is less than you'll pay for some higher-quality monitors, it is perhaps not significant enough to justify making this the choice over more costly competitors.

TVM Professional Monitor Corp.

TVM LowRadiation 5A+

BY BRUCE BROWN

The \$647 TVM LowRadiation 5A+ is a microprocessor-based 15-inch unit with decent performance but a slightly high estimated street price of \$559 to \$599.

Along with a 0.28-mm dot pitch, the TVM 5A+ has a flat square CRT with an Invar shadow mask. It measures 13.5 inches from bezel to bezel. The dark-tinted antiglare treatment doesn't affect the brightness and allows just a bit of reflection. Its top resolution is 1,024-by-768 noninterlaced at a vertical refresh rate of 72 Hz, or 1,280-by-1,024 interlaced at 88 Hz. At 800-by-600, it runs at up to 72 Hz.

The unit has mode-based auto-sensing, eight factory presets for standard Video Electronics Standards Association (VESA) and VGA modes, and seven user-defined settings. Standard controls are on the front; vertical position and interlace controls are located somewhat awkwardly on the back.

SuperSpot results were respectable.



VGA vertical pincushioning was not noticeable in subjective testing, though the score was a little high. Super VGA pincushioning scores were acceptable. There was slight tight-text muddiness but no moire patterning. Despite the mode-sensing, we had to readjust the image size a little when switching to 1,024-by-768 noninterlaced mode. The TVM 5A+ also had a hefty jump in regulation testing and a slight click in switching from text mode to graphics mode. Consider this one if you can find it at the street price or better.

ViewSonic

ViewSonic 5E

ViewSonic 6

BY M. DAVID STONE

ViewSonic offers the \$499 ViewSonic 6 as its low-cost, 14-inch 1,024-by-768 noninterlaced monitor and the \$599 ViewSonic 5E as its high-end model in that category. At \$329 on the street, the ViewSonic 6 may be of interest to users watching their wallets. The ViewSonic 5E is a little less budget-minded, with a street price of \$410. Both products, however, have notable flaws.

A 0.28-mm dot pitch, analog controls, spherical section tubes with conventional shadow masks, and a silica coating to reduce glare are some of the features

shared by these variable-frequency scanning models. The ViewSonic 5E earns its high-end status partly by supporting a 72-Hz vertical refresh rate at the maximum noninterlaced resolution of 1,024-by-768, while its sibling manages only 60 Hz in that mode. The

ViewSonic 6 has a visible diagonal screen size of 13.5 inches; the ViewSonic 5E offers 13.4. You will probably find a 14-inch unit too small to run in 1,024-by-768 mode and that the ViewSonic 5E's higher maximum refresh rate at that resolution might not matter all that much.

The standard controls for both moni-



The ViewSonic 5E and ViewSonic 6

tors are located below the screen. The ViewSonic 6, however, is missing a vertical-position control; you have a choice of either not seeing the whole image or seeing a flattened image in which circles appear oval.

The monitors generally performed within acceptable range on the Superspot Average MTF, Luminance, and Pincushioning tests. The Misconvergence scores were a little on the high side for both, however, as was the Vertical Pincushioning score for the ViewSonic 6. But this did not produce objectionable results on subjective viewing. Alas, the monitors showed problems on other subjective tests. When changing from graphics mode to text mode, the ViewSonic 5E scrambled the image for about a second before settling down, and the ViewSonic 6 took even longer.

Although both simulate autosizing for some modes, they don't provide it at 72 Hz for any resolution. You can expect to adjust the image with each mode change.

Ultimately, the only reason to consider these monitors is if you're on a tight budget and can get them at rock-bottom prices. Otherwise, it's hard to recommend them when there are digital 14-inch monitors, such as the ADI MicroScan 3E, Optquest 1500D, and Compaq 1024 Color Monitor, available at street prices starting at \$365 or so.

WEN Technology Corp.

WEN JK1466 Color Monitor

BY BRUCE BROWN

The \$440 14-inch analog WEN JK1466 sells on the street for about \$350. It doesn't boast any startling features, but

it provides a decent value for the price.

The unit offers variable-frequency scanning and supports a 72-Hz vertical refresh rate at both 800-by-600 and its maximum 1,024-by-768 noninterlaced resolution. Like most of the other 14-inch monitors in this review, the JK1466

has a 0.28-mm dot pitch and a spherical tube with a conventional shadow mask.

The JK1466 provides a visible display area of 13.5 inches. The etched screen shows only very slight reflection.

Superspot testing went smoothly, and although VGA vertical pincushioning was not readily obvious to the naked eye, the score of 0.958 was a little high. Subjective tests showed little muddiness or



The WEN JK1466 Color Monitor

moire patterning, though there was moderate image pulsing and a little mode-switch bouncing.

The unit's mode-sensing had some trouble maintaining a constant image size across the resolutions. The JK1466 also lacks a horizontal-size control, and all other controls, except brightness and contrast, are located inconveniently on the back. The JK1466's low-radiation option costs \$25.

WEN has two other 14-inch monitors: the dual-frequency \$345 JK1461 and the \$599 JK1450 (with a noninterlaced resolution of 1,024-by-768).

This isn't a terribly exciting monitor, but it isn't meant to be. Standard features and a relatively low \$350 street price make it an acceptable buy. □

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MAKING THE WAN CONNECTION

Linking LANs

We examine three commonly used methods for successfully connecting your widely separated LANs.

Businesses grow while the local networks they depend on stay hobbled by their cables. High-speed LANs typically don't extend beyond a few thousand feet of wiring, so expansion may leave you with islands of local networks strung out across a campus, across a town, or across the country.

How are you going to link those LANs? You could use a modem, and for some small businesses, that will work just fine. Modems are inexpensive and fairly easy to use and install. After the hardware purchase, the cost of a dial-up line is the only expense.

But for many businesses, analog modems cannot offer the capacity to connect two or more offices. Even high-speed modems running 4:1 compression are often unable to handle a heavy volume of binary files, some of which may be virtually uncompressible. And not all modems will be able to transfer data coming from the bridges and routers linking your LAN segments.

by Frank J. Derfler, Jr.



Wide-Area Networks

Putting together that link isn't difficult if you make the right connections—high-speed digital connections. You'll need some special hardware, along with information about your system's needs, to pick the right digital data service to supply those connections.

Bridges, routers, and gateways all pass data from the individual LANs to special equipment that attaches to long-distance connections (see the diagram that accompanies "Linking LAN Islands"). Each offers a different level of sophistication at passing data from site to site.

Digital data connections come in three varieties: circuit-switched, leased-line, and packet-switched. Circuit-switched and leased-line networks are "open-pipe" services, in which data moves in a stream to one destination. With circuit-switched service, your inter-networking device dials up another LAN, transfers the data, and then hangs up; it's much like a voice telephone call. A leased line gives you a dedicated, permanent link between two LANs; it's like leaving the phone line permanently open.

Packet-switched networks send discrete sections of your data onto a digital datacomm web, where it can move to any number of other LANs; these services are similar in structure to a huge network, on which each LAN acts as a node.

You'll typically lease digital interLAN circuits on a monthly basis as a service from one or several commercial telephone companies, also called commercial carriers. Local carriers control the local telephone lines to a given region. Long-distance or interexchange carriers control the phone lines that link these regions.

Because of differences among carriers and among the state public-utility commissions, the rates for all types of digital services vary widely. You will also need to contend with up-front costs for circuit interface equipment, additional recurring costs for special services, and even special taxes on telecommunications services. Leasing a fast long-distance link between LANs can consume tens of thousands of dollars a month, so careful planning and management is imperative.

To select the right service for your office, you must consider four factors:

Signaling speed Speeds for current long-distance services range from 19.2 kilobits per second to 45 megabits per second. Local carriers generally offer local and long-distance service at speeds of 56-, 64-, and 384 Kbps and 1.544 Mbps, but every service speed is not available in every location. You will often hear speed referred to as "capacity," since the measurements used to define service speed actually define how much data can move across the link per second.

The faster the connection, the more expensive it is. You will want to know how much data your LAN actually transfers across the link at any given time so you don't buy too much service or limit your networks with too little.

Duration Establish how long you'll need to be connected, and how often. You might need a LAN-to-LAN session every minute of the day, or your applications may require 15-minute sessions 10 times

HIGHLIGHTS

Wide-Area Networks

THREE ALTERNATIVES for linking LANs into wide-area networks are circuit-switched, leased-line, and packet-switched connections.

CIRCUIT-SWITCHED connections are similar to standard voice lines. You dial up the receiving computer, transfer the data, and then terminate the link. Leased lines are permanent circuit connections that are always available without any required setup time. Both types of connections can connect two offices.

PACKET-SWITCHED networks are the best way to connect more than two offices. They function much like large LANs. Data is carried in packets that have the source address of the sending network and the destination address of the receiving network. The data moves through network switches that look at this information and forward the

packet onto the next switch until it eventually reaches its final destination.

FRAME RELAY AND X.25 are the two types of packet-switched networks. Both types are roughly comparable to the Ethernet and Token-Ring LAN specifications. X.25 provides lots of error checking to ensure proper delivery of the data. Frame relay is essentially a stripped-down version of X.25. It lacks much of X.25's error checking but has greater speed and requires less overhead.

CELL RELAY, which is also called asynchronous-transfer mode (ATM), is an emerging variant of packet switching. By assuming a fixed-length packet or cell, cell relay requires less overhead and brings better performance. Cell relay may become the first WAN technology that can not only connect net-

works together but can link PCs as well.

WHEN YOU ORDER access to a WAN service, have the area codes and exchanges available for all the offices you need to connect.

ORDERING A WAN connection isn't like buying a PC. Pricing is very complex and estimates don't come easily, particularly when hardware is involved.

ESTABLISHING A WAN LINK involves pricing the cost of the lines from your network to your central office, from that office to the central office of the network to which you want to connect, and from the remote central office to the destination network. Naturally, the costs may change if both networks share the same central office or if more than one interexchange carrier is required to link the two offices.

LAN-to-LAN Glossary

asynchronous-transfer mode (ATM) A form of packet switching, a subset of cell relay that uses 53-byte cells as the basic transport unit. In concept, ATM circuits of different signaling speeds can move data from desktop to desktop and across long-distance services without major changes in data format.

automatic number identification (ANI) A feature, often associated with ISDN, that passes a caller's telephone number over the network to the receiver so that the caller can be identified. Also known as "caller ID."

basic-rate interface (BRI) The ISDN standard governing how a customer's desktop terminals and telephones can connect to the ISDN switch. It specifies two 64-Kbps B channels that allow simultaneous voice and data service, and one D channel that carries call information and customer data at 16 Kbps.

bridge An internetworking device that connects two networks together at the Media Access Control (MAC) layer of the OSI model. Transparent bridges look at every packet on one network and forward those packets destined for another network through the appropriate port. Source-routing bridges use special information, embedded inside the packet by the originating device, to forward the frame toward the packet's destination. Since the bridge does not read the network address of the packet, bridges are protocol independent and (unlike routers or gateways) can route packets without understanding them. Bridges are also typically cheaper and easier to install and manage than routers.

central office (CO) The telephone-switching station nearest the customer's location. The central office serves the businesses and residences connected to its local loop lines.

channel service unit (CSU) The piece of equipment that terminates the long-distance circuit in the customer's location. It is often paired with a digital service unit (DSU).

circuit switching An open-pipe technique that establishes a temporary dedicated connection between two points.

committed information rate (CIR) The transport speed the frame relay network will maintain between service locations.

digital service unit (DSU) A synchronous serial data interface that buffers and controls the flow of data between a network portal, such as a bridge or router, and the channel service unit.

frame bandwidth allocation The sum of the committed information rates associated with all the permanent virtual circuits for a specific customer.

gateway Like bridges and routers, a method of connecting two local area networks. Gateways translate between two LAN protocols. For instance, an Ethernet LAN can be linked to an X.25 network through an X.25 gateway. Gateways are protocol-specific and can only translate between two types of networks.

interexchange carrier (IXC) Essentially, a long-distance telephone company. Interexchange carriers may offer circuit-switched, leased-line, or packet-switched service, or some combination of the three.

leased line An open-pipe communications circuit reserved for the permanent use of a customer.

local exchange carrier (LEC): The local telephone company.

local loop The connection between the customer's location and the telephone company's central office.

open-pipe A description of how data moves on a circuit-switched or leased-line digital data connection. In an open-pipe connection, data moves in a steady stream. It is not in packets, and all of the data follows the same path from the sending LAN to the receiving LAN.

packet assembler/disassembler (PAD) A device that converts the serial data stream coming from an internetworking device such as a bridge or a router into packets for a packet-switched network.

packet-switched network A network consisting of a series of interconnected switches that route individual packets of data over one of several redundant routes. Most commonly, packet-switched networks refer to X.25. Packet-switched networks offer flexibility for multipoint connections, high reliability, and flexible pricing.

permanent virtual circuit (PVC) A logical, nonphysical link established by the packet switches between

service locations. This compares to the open-pipe link, which is a physical link.

port speed: The maximum signaling rate on a digital access line.

primary rate interface (PRI) A bundle of ISDN circuits. In the United States, it consists of twenty-three 64-Kb channels and one 64-Kb D channel. This is the equivalent of one T-1 link. In other parts of the world, the PRI has 30 B channels and one D channel—the equivalent of one European E-1 link.

router A device used to connect the wires from one or more networks together. Routers examine the network address of each packet. Those packets that contain a network address different from the originating PC's address are forwarded onto an adjoining network. Routers also have network-management and filtering capabilities, and many newer routers incorporate bridging capabilities as well. Since routers must read network addresses, they must know the network protocols for the packets they receive; for example, a router receiving NetWare packets must support IPX, Novell's network protocol. Routers offer finer traffic control than bridges but are typically a bit more expensive and much more difficult to install.

Switched multimegabit digital service (SMDS)

Any of a variety of switched digital services ranging from 1.544 megabits to 44,736 megabits per second.

T-1 A 1.544-Mbps communications circuit provided by long-distance carriers for voice or data transmission. T1 lines may be divided into twenty-four 64Kb channels. This circuit is common in North America. In Europe, the analogous lines are called E-1. They have a line speed of 2,054 Mbps. Elsewhere, the T-1 is superseded by the CCITT designation DS-1.

T-3 An AT&T standard for dialed-up or full-period leased-line circuits with a signaling speed of 44,736 megabits per second. Superseded in Europe by the CCITT DS-3 designation.

value-added network (VAN) A packet-switched network that offers high reliability and such services as protocol conversion and data buffering.

X.25 - A CCITT standard that describes how data is handled in a packet-switched network and how computers can access such a network.

Wide-Area Networks

a day. A series of brief connections can be much less expensive than a dedicated connection. If you require a total of more than 3 hours of connection time a day, consider a dedicated connection.

Reliability Both reliability and restoration capability are important. You'll want to know whether the company you choose has the resources to restore service quickly in case of outages.

Many service vendors now provide sophisticated reporting programs for leased-line and packet-switched services. Find out what kinds of management reports are provided, the types of reporting procedures available in case a malfunction occurs, and the reimbursement plan offered for service interruptions.

Ordering and billing In the United States, ordering and paying for commercial telephone services can be complex and confusing. When you use local-access service, you will receive separate bills from each service provider. With direct connection, the interexchange carrier con-

solidates all bills. As a general rule, try to use the carrier that will provide most of your business as the single point of contact for setting up the service. Consolidated billing reduces your overhead because your accounting department handles fewer pieces of paper and writes fewer checks. Nonconsolidated billing makes it easier to see how much you spend on a particular circuit, however.

OPENING THE PIPES

Open-pipe digital connections, whether they be circuit-switched or leased-line services, offer economical and flexible LAN-to-LAN links. They are a logical extension of the digital capabilities built into modern telephone systems. The major portions of the telephone systems in North America, Europe, and much of Asia are fully digital.

With circuit-switched services, a bridge or router dials another bridge or router through the phone network. Using a data-link control protocol such as IBM's Synchronous Data Link Control (SDLC) or the more widely used High-

FACT FILE

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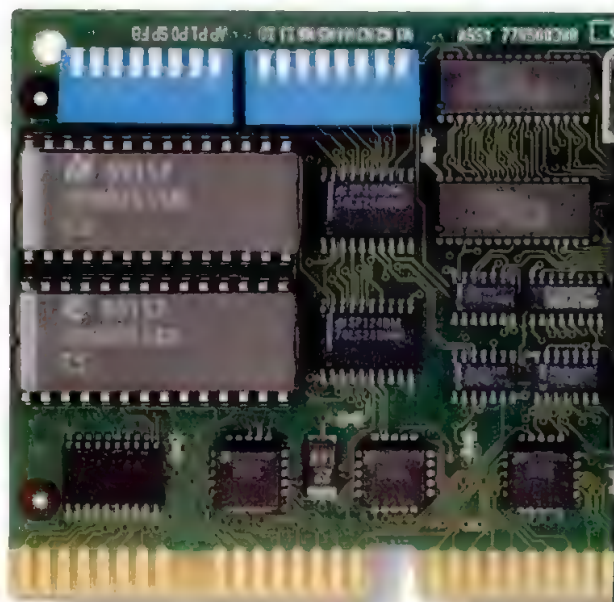
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level Data Link Control (HDLC), the sending LAN's bridge or router encodes the data onto the digital line and passes the data to the receiving LAN's bridge or router (see the diagram that accompanies "Circuit-Switched Service").

Circuit-switched service, in which the sending LAN dials up the receiving LAN as necessary, might be appropriate for connection periods of eight hours or less per day, but if your connections last for more than three hours a day, evaluate your options carefully.

Switched services are particularly well-suited for applications requiring part-time connections, and as alternative connections when overloads or other emergencies occur. Circuit-switched services can also be appropriate in other short-term situations. Electronic-mail servers, for example, can use circuit-switched services to update the mail database quickly. Network databases can also benefit from switched digital services by using the higher capacity of those services to update inventory and order records in less time than the other options.

Carriers offer several types of circuit-switched services. Perhaps the best known is ISDN (Integrated Services Digital Network). To date, ISDN has been little more than talk. In theory, ISDN offers fast signaling between the customer's terminal and the switching center, making it possible to connect in milliseconds, instead of the full seconds that other circuit-switched connections require.

It's easy to think of ISDN as a pair of switched 64-Kbps lines. You can send data between two PCs over one channel while simultaneously using the second channel as a voice telephone line. (A third 16-Kbps line is used to negotiate, establish, and tear down the circuit.)

A lack of consensus throughout the industry about certain billing and ordering procedures has prevented the specification from really taking off. Vendors have taken other approaches to gain ISDN's fast switching capability, one of which is Switched 56. Switched 56 operates much like ISDN, but instead of two 64-Kbps channels, Switched-56 offers just one 56-Kbps line for data transfer.

FACT FILE

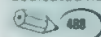
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AT&T's services include ISDN, dedicated leased lines, and an X 25 and a frame relay network, all part of the AT&T InterSpan family. These solutions include Switched 56, Switched 384, and Switched T1 services. The company offers a wide range of leased-line services and end-user equipment.

The AT&T InterSpan Frame Relay Service offers more than 100 U.S. service-access points. AT&T's frame relay service is priced for each subscriber on a contractual basis. The cost is initially based on the speed of the access line and the committed information rate, although other arrangements are possible. AT&T provides for toll-free 14.4-Kbps (V.32bis) dial-in service.

The AT&T StarSentry system lets organizations gather statistics and other information about system performance through SNMP stations. AT&T has a large field-service and customer-support organization and a dedicated network-operations center.



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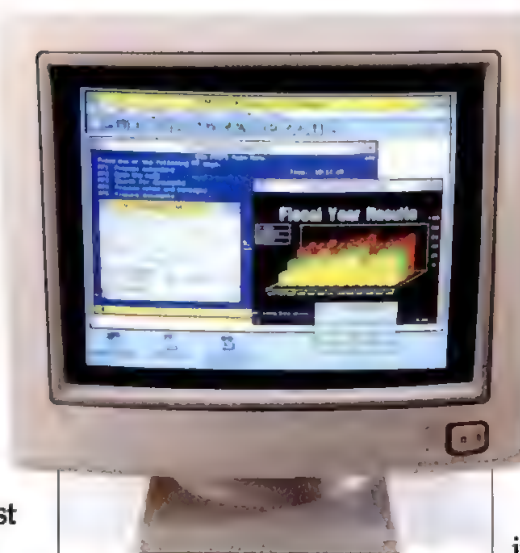


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■ Linking LAN Islands

by Frank J. Derfler, Jr.

Connecting widely separated LANs with digital data links requires an assortment of hardware. That hardware can cost several thousand dollars, but the one-time hardware expenditure is small in comparison to the recurring monthly costs of the data lines that link the hardware.

All LAN-to-LAN links begin with a bridge or router. These multiport devices contain a bus to which one or more LANs and one or more data lines are connected, along with some amount of buffering RAM and network-management programming.

The bridge or router controls the flow of data between the LAN and the long-distance circuits, sorting the data streams and processing them for transmission with any of a number of protocols appropriate to the various data links onto which the data might move.

Whether you choose a bridge or a router—and also the type, complexity,

and cost of the bridge or router you choose—depends mainly on components already present on your LAN. If the two networks use the same network-signaling and access-control protocol, you'll choose a bridge. The LAN in the accompanying diagram is an Ethernet LAN with an Ethernet bridge. If the networks are different—if one uses Ethernet and the other uses Token-Ring, for example—choose a router.

The bridge or router connects on one side to the local area network and on the other side to an intermediate device. What exactly this device will be is determined by the type of data-link service you choose.

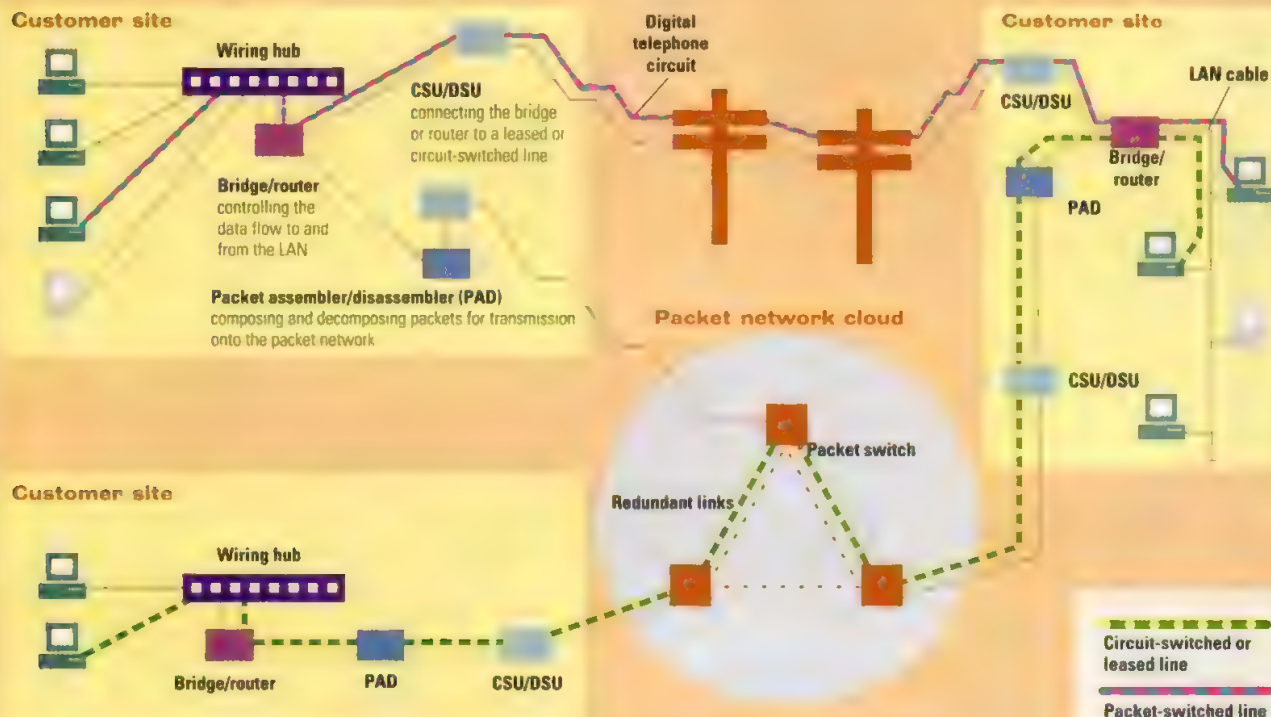
With leased lines and circuit-switched connections, the bridge or router connects to a channel service unit (CSU) and a digital service unit (DSU). The channel service unit provides the physical and electrical termination for the telephone wiring.

The channel service unit is specific

to the type of long-distance circuit you order. You can ask the carrier providing the circuit to also provide the channel service unit—often for a monthly lease—or you can provide your own. The digital service unit is a serial data port that provides a connection, typically RS-232, RS-449, or V.35, between the channel service unit and the router.

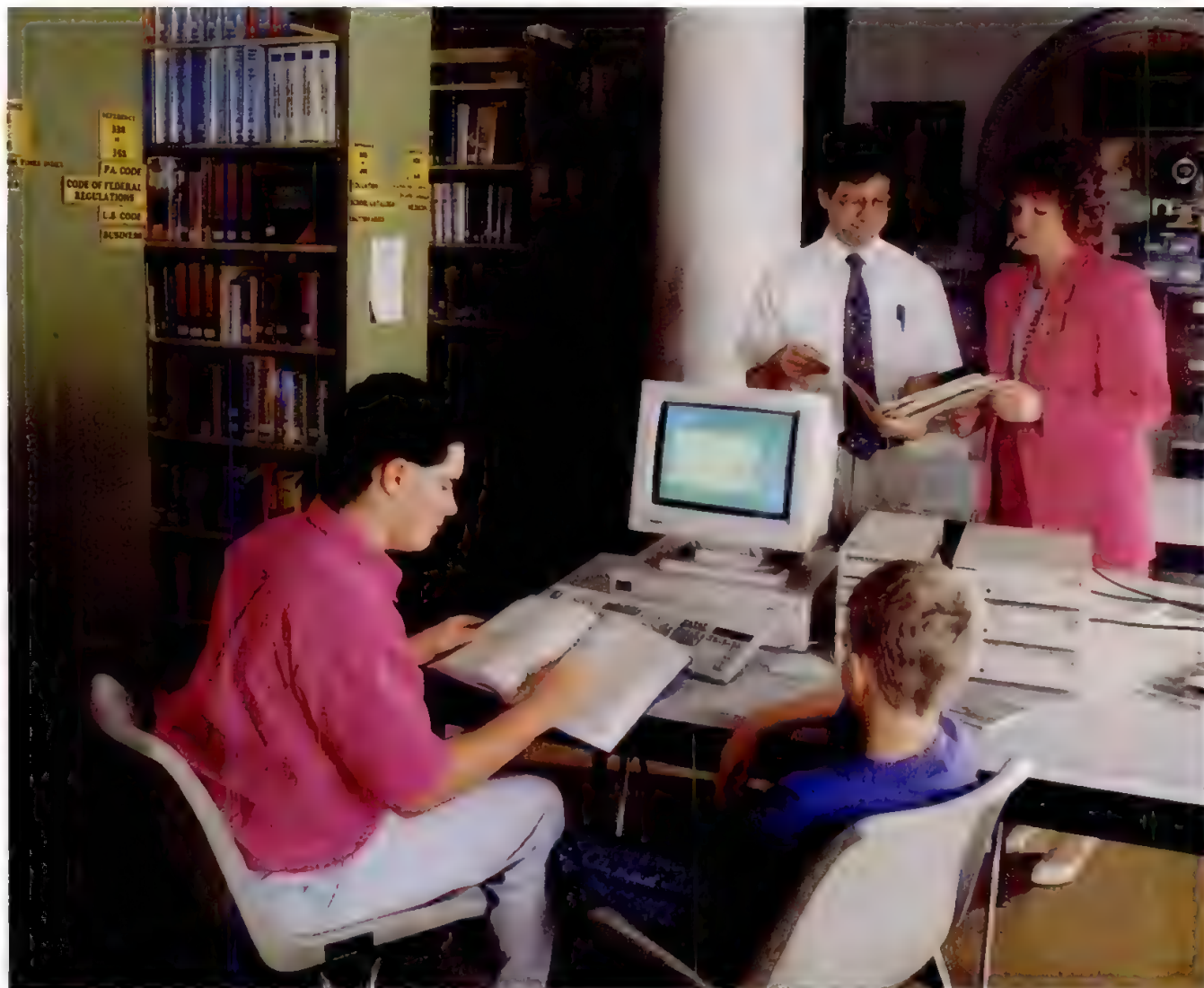
In connecting to packet-switched networks, a third element known as the packet assembler/disassembler (PAD) sits between the CSU/DSU and the WAN link and prepares the data to flow between the networks. The PAD on the sending LAN bundles the moving data into packets, and the PAD on the receiving LAN unbundles the packets as they arrive.

Although the diagram shows all of these devices as separate boxes, the newest bridges and routers often contain their own internal DSUs. Moreover, bridges, routers, and even CSUs often occupy slots in wiring hubs. □



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April 14, 1992
LANtastic, Version 4.10

MAGAZINE
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CIRCLE 254 ON READER SERVICE CARD

▶ FACT FILE

BT North America
2560 N. First St., P.O. Box 49019, San Jose,
CA 95161; 800-872-7654, 408-922-0250

BT North America, part of British Telecom, owns the Tymnet packet-switching network. BT North America has more than 100 offices in 30 countries and offers service in more than 1,100 cities in over 100 countries. Tymnet offers X.25 services with a variety of value-added capabilities, such as protocol conversion for many IBM and Unisys products, electronic data exchange, and videoconferencing. Tymnet provides dial-up access to the X.25 network in 850 U.S. cities.

BT offers frame-relay access speeds from 56 kilobits per second to 2 megabits per second. BT's Concert network-management system has ties to network-management programs sold by Hewlett-Packard Co., Ungermann-Bass, and other companies. The system also has SNMP MIB (Simple Network-Management-Protocol management information base) reporting options. The company is developing a variety of services, ranging from dial-up access to WAN links to gateways between frame relay and X.25 services. BT North America has been a pioneer in international frame relay services—you should look at them closely if you need service in Europe or Asia.

 ON READER SERVICE CARD

Pricing for circuit-switched services generally follows the familiar scheme of voice-line rates. You pay for equipment, installation, and a monthly service charge, and you pay for each call at a per-minute rate based on the distance.

Determining a price involves many variables, but some guidelines apply. Expect to pay between \$50 and \$75 each month for circuit-switched services. Usage charges for Switched 56 service vary from 8 to 30 cents per minute, depending on the distance covered. A 1.544-Mbps T1 line has from 24 to 30 times the capacity of a Switched 56 line; accordingly, usage rates range between \$2.40 and \$6.50 per minute, or 20 to 30 times as expensive as Switched 56 (for more information on costs, see the table, "Pricing the WAN").

When an interexchange carrier sets up a switched-access line, it can either work with the local carriers in each service location (an arrangement called switched-digital access) or it can arrange for circuits that connect your service locations into the long-distance network without going through the local-dial network (an arrangement known as direct connection). In its purest form, when the interexchange carrier buys no service from the local carrier, direct connection is known as bypass.

Most local-exchange carriers place a different amount of emphasis on switched services, an emphasis that is reflected in how much support they give them and how much they charge for them. In some areas, for instance, Switched 56 service costs no more than voice service, but in other areas it carries a high premium. Some local-exchange carriers, particularly the GTE telephone companies, strongly support switched services. Other local carriers support these types of services less aggressively. Among the interexchange carriers, AT&T places a particularly strong emphasis on switched services.

This hodgepodge of service and pricing is changing. An organization called the Switched Digital Services Applications Forum, made up of vendors of local and long-distance service, is developing a set of quantifiable ratings for vendors of switched-data services. The organization provides reports that rate specific elements, such as how well interexchange employees understand the service, how long it takes to complete the installation

▶ FACT FILE

CompuServe Inc.
5000 Arlington Centre Blvd., P.O. Box
20212, Columbus, OH 43220; 800-433-0389,
614-457-8600; fax 614-457-0348

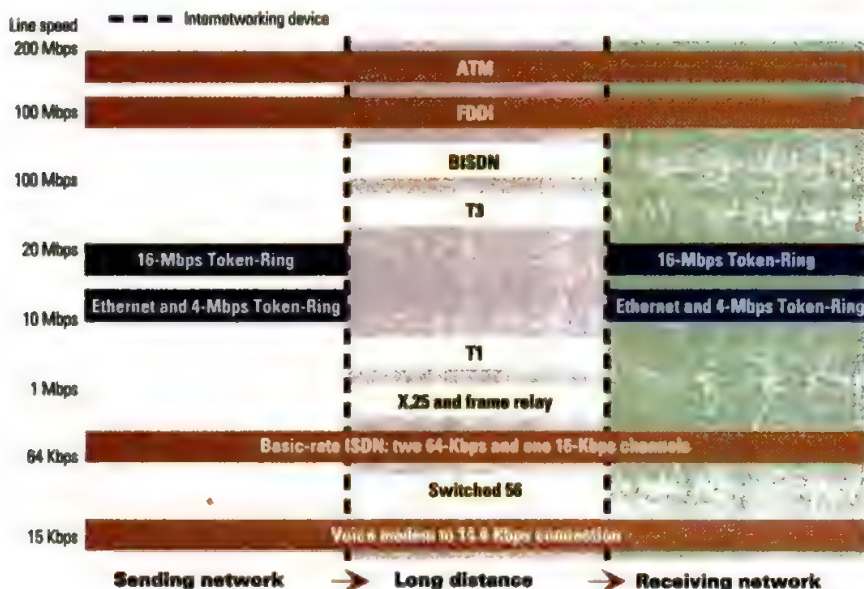
In addition to its well-known CompuServe Information Service, CompuServe offers a public X.25 data network service and a frame relay service called Frame-Net.

The CompuServe X.25 and Frame-Net services are part of an international network offering access speeds ranging from 56 kilobits per second to 1 megabit per second. The cost is determined by the speed of the link, called the Frame Bandwidth Allocation, and the cost of the connecting digital-access circuit, called the Frame Network Link. The Frame Network Link charge includes the DSU/CSU. CompuServe provides dial-in access to the X.25 network, and the company plans to add dial-in service to Frame-Net sometime this year.

CompuServe's product-support group provides technical expertise for customers. CompuServe's labs will also test LAN equipment to ensure compatibility with the X.25 and frame relay networks. Its Network Control Center provides 24-hour service that includes monitoring of the CompuServe-provided CSU/DSU installed at the customer's facility.

 ON READER SERVICE CARD

Comparing Connectivity Approaches



Some of the techniques that connect nodes to form a LAN can also connect LANs in a WAN. These include ATM, FDDI, and ISDN. Others, such as Ethernet and Token-Ring, are specific to forming LANs. Still others, such as BISDN, T3, T1, X.25 and frame relay, and Switched 56, can form the WAN connection between LANs.



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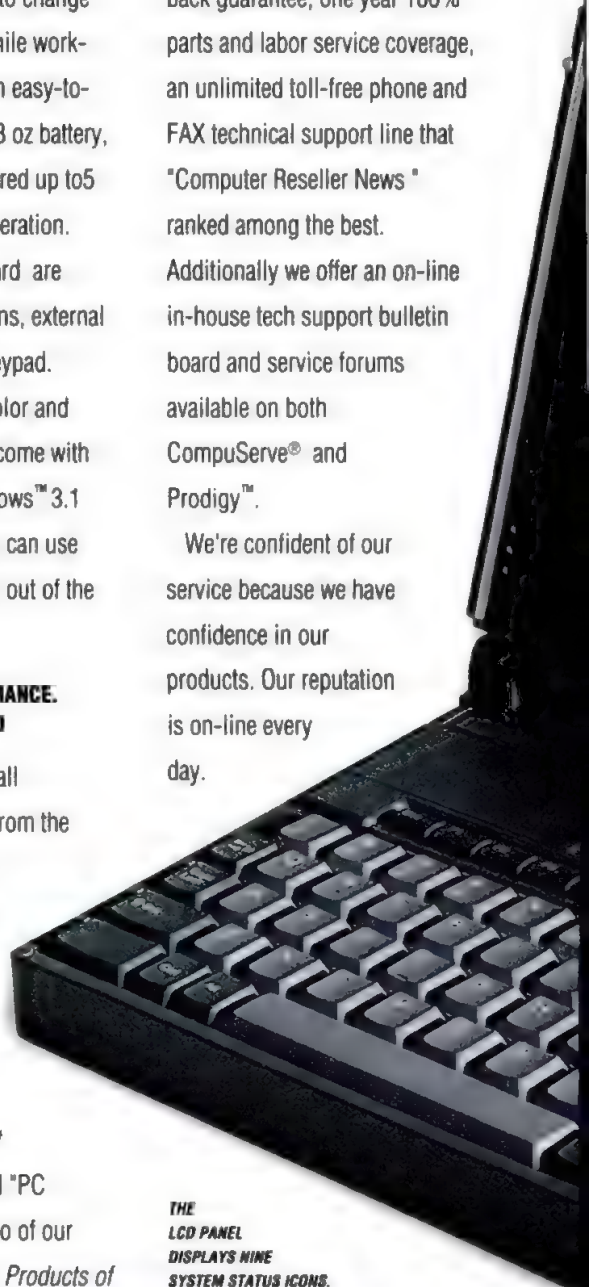
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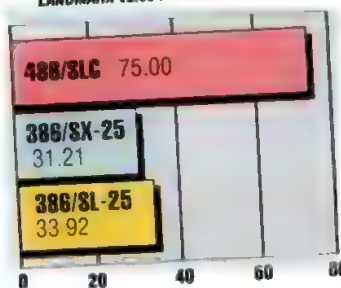
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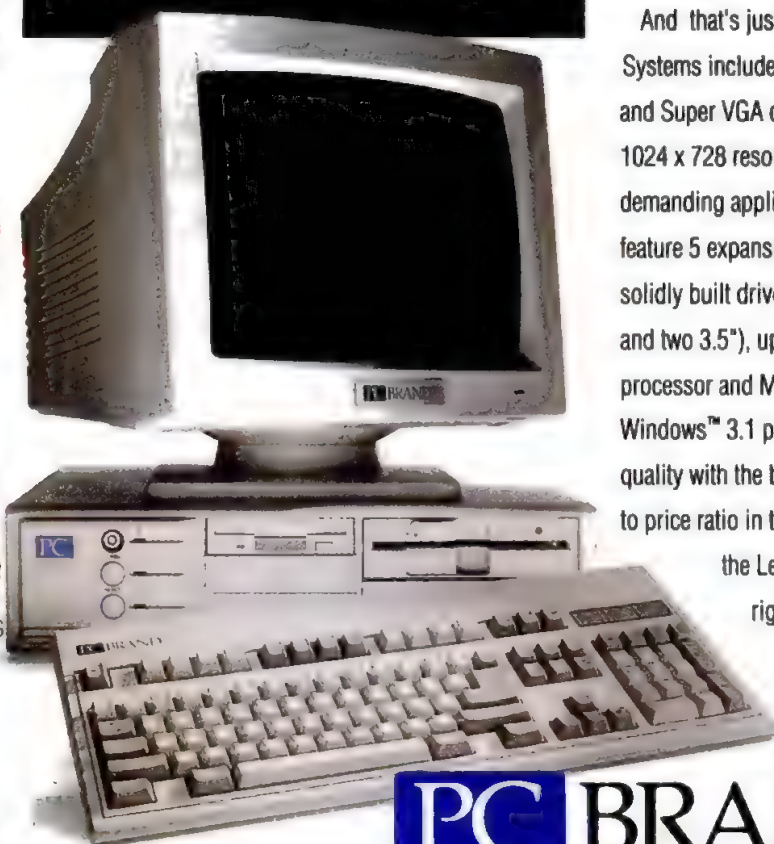
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■ Circuit-Switched Service

by Frank J. Derfler, Jr.

Circuit-switched services rely on an interface device that is a combination of a telephone dialer and a channel service unit (CSU). The Northern Telecom Datapath, which looks a lot like a standard modem, is typical of these devices.

When the interface device detects an appropriate control signal on the RS-232 or V.35 serial link to the bridge or router, it initiates the call. Some bridges and routers are equipped to send the correct telephone number and

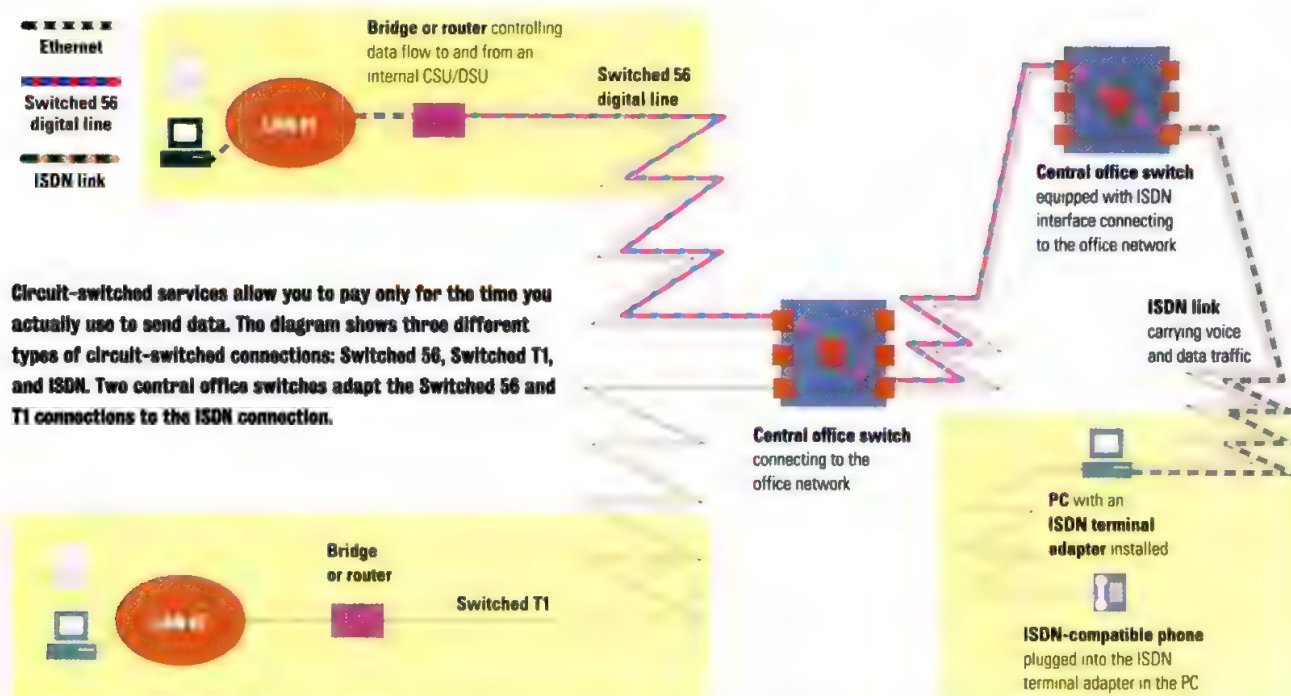
signals with those of other clients for long-distance communications.

If the connection goes outside of the area covered by the local telephone company, the circuit goes to a *point of presence* (a technical and legal interface point, but often just an equipment rack) maintained by an interexchange carrier. The interexchange carrier takes the data across its long-distance network and routes it to the point of presence closest to its destination. There, the local telephone company at the destination completes the connec-

services, including data and voice.

ISDN (Integrated Service Digital Network) has been touted for some time as the next big thing for data lines. ISDN looks like any other switched-circuit network. The difference between ISDN and the other switched-circuit networks is in the extra signaling and control capabilities available in the ISDN interface device and in the computers in the local telephone company's central office.

The ISDN service that will probably be used to link LANs is called basic



even alternate numbers to the interface device, and others simply toggle a control line to tell the interface device to dial its own stored numbers. Like a modem, the switched-circuit interface device can answer incoming calls. The switched-circuit interface device connects to a digital-access line, also called a digital local loop, going to the central office of the local telephone company. The central office houses computer systems that batch the incoming digital

tion over another digital-access line. In some cases, the interexchange carrier might provide a direct connection from the point of presence to the termination and bypass the local carrier.

This configuration is generally the same for Switched 56 (56 Kbps) and Switched T1 (1.544 Mbps). The Switched T1 service might go through another device called a channel bank or multiplexer, where the data is broken into slower channels for various

rate interface (BRI). This service delivers two data channels of 64 Kbps each, called bearer or B channels, and a separate 16-Kbps channel, called the data or D channel, used to signal the computers in the telephone-switching system so they know what to do with the B channels. The D channel provides a way to generate calls quickly, to reset calls, and to receive information about incoming calls, including the identity of the caller. □

NETWORKING

Wide-Area Networks

FACT FILE

GE Information Services

401 N. Washington St. Rockville, MD 20850;
800-433-3683, 301-251-6510

While GE Information Services (GEIS) provides end-to-end data transport for the U.S. and Canada using frame relay or X.25 services under the product name MARK*Net, the company focuses on higher-level service. GEIS will arrange for local-access lines and can arrange for connections to international carriers. MARK*Net offers X.25 services, including dial-in at 9,600 bits per second and IBM SNA synchronous connections.

If you need to connect dissimilar electronic mail systems, MARK*Net can translate between a dozen of the most common LAN and mainframe e-mail systems. MARK*Net also offers translation between many asynchronous and synchronous protocols.

BusinessTalk provides access to specialized business databases; the GEIS Sales and Marketing Communications System provides sales automation services that GEIS will customize to any organization. GEIS delivers these services in approximately 70 countries.

ON READER SERVICE CARD

after it has been ordered, how reliable the service is, and what restorative actions the carrier will take. U.S. carriers are also trying to stabilize and standardize the cost of switched digital services.

LEASED LINES

If you must transfer a high volume of information between two offices frequently, look into digital leased lines. These lines give you a permanent, though more expensive, circuit between two offices. You lease the circuit on a monthly basis instead of calling it up as needed.

With leased-line service, bridges or routers use a data-link control protocol to transmit data. Line speeds range from 19.2 Kbps to 45 Mbps. U.S. phone systems support a group of rates known as the "T-services." These are the speeds at which the line operates. T1 refers to a 1.544M-bps link, while T3 is a 45M-bps link. (There are also circuit-switched connections for T1 and T3.)

The T1 or T3 lines can be subdivided into multiple smaller channels at either LAN by using a multiplexer. The multi-

plexer encodes data at different frequencies; each frequency is a different data channel. A T1 line may be split into a total of 24 64-Kbps channels.

Many carriers will sell you a single 64-Kbps channel called Fractional-T1. Some carriers, such as AT&T, do allow you to lease circuits that let you increase the speed of service with a few minutes of notifying the carrier, but you'll pay extra for such flexibility.

A transcontinental full-period T1 line costs approximately \$20,000 per month. Consider buying your leased-line service from a vendor with whom you already do business; prices vary widely, depending on the amount of other services you're purchasing from the supplier.

Either a local or interexchange carrier can install your leased line. Which you choose will depend on the location of the offices you plan to connect. Local telephone companies are a better choice if both networks are located in the same operating area; an interexchange carrier is a better choice if they are in different areas. Charges are based on the line speed

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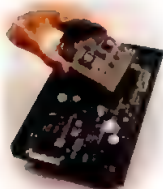
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Wide-Area Networks

of the service and the distance of the circuit; they also may include special access fees imposed by local carriers.

SWITCHING THE PACKETS

If you are linking two offices together, circuit-switched and leased lines are perfect solutions. But when you start connecting more than two offices, a third alternative called packet switching begins to shine.

Packet-switched systems use several different technologies, most notably X.25, frame relay, and cell relay. All of these technologies replace HDLC with a different signaling protocol and add a method of directing the packets between multiple destinations. With a packet-switched network, you can connect multiple offices using redundant, and thus more reliable, links. And you can add these links more economically than with

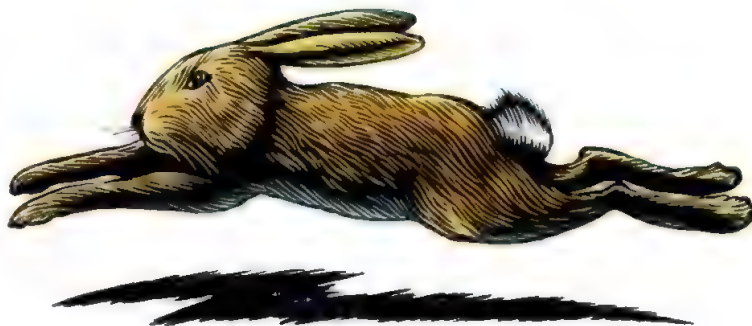
leased or dial-up digital lines.

Each office connects to a digital-line switch in a network of switches. Each switch handles specially formatted packets of data that contain a block of data from an application program or file, the address of the originating network (the source address), the address of the destination network, and other data, including the age of the packet and error-control

information. At each LAN, a special piece of equipment called a packet assembler/disassembler (PAD) composes the outgoing packets and reads the packets coming in from the packet-switched network (see the diagram accompanying the "Packet-Switched Networks" sidebar).

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FACT FILE

MCI Communications Corp.

1801 Pennsylvania Ave. NW, Washington, DC 20006; 800-933-9029, 214-701-6771

MCI, along with AT&T and Wiltel, is one of the "do-everything" carriers. The company's Virtual Private Data Services (VPDS) provide an umbrella for all circuit-switched, leased-line, and packet-switched data services. MCI offers circuit-switched data service at speeds that start at the standard 56 Kbps and extend past T1 and T3 to the new MCI HyperStream multimegabit data service at 45 Mbps. The MCI network is also ISDN-ready. MCI offers switched data services at 300 access points in the United States. You can buy MCI leased-line services in several configurations.

MCI began marketing its VPDS frame relay product in 1992; they offer no X.25 service. The frame relay system uses a backbone of cell relay switches, so it's easily expanded to asynchronous-transfer-mode services. MCI supplies everything, including the CSU/DSU.

MCI prices frame relay on a contract basis and can arrange for either fixed-rate or usage-sensitive pricing. The usage-sensitive pricing scheme lets you use the MCI frame relay system as a backup to other connections, such as full-period leased lines.

MCI customer service and support is free. The network has an extensive management system. The frame relay management system acts as an SNMP MIB and it can be queried by many of the popular SNMP management programs.

432 ON READER SERVICE CARD

■ Packet-Switched Networks

by Frank J. Derfler, Jr.

Packet-switched networks, which can link more than two LANs simultaneously, offer flexibility, reliability, error control, management reporting, and usage-sensitive billing. The accompanying diagram shows two LANs, both of which have a full-period connection into the packet-switched network.

Each packet assembler/disassembler (PAD) takes the output from the bridge or router and encapsulates it into packets designed to cross the network. The packets contain addressing information used by the packet switches to determine the best route. This route is determined on a packet-by-packet basis. This ability to find the best route among alternative routes improves reliability.

The switches reorder any packets that travel over a longer route and arrive at their destination in the incorrect

order. Many of the newer bridges and routers contain their own PAD and channel service unit/data service unit (CSU/DSU); but some interexchange carriers supply the customer with channel service units and data service units as they are needed for each link. The PADs and CSU/DSUs buffer outgoing packets and mediate between LANs that are connected into the network at different access speeds.

Different packets formats have different advantages. The CCITT X.25 protocols are very robust and ensure transmission of the packet even in the face of degraded communications circuits. The frame relay system is less robust, but provides better efficiency as well as higher throughput over high-quality circuits.

Cell relay or asynchronous-transfer-mode (ATM) systems are just arriving in the market. They promise

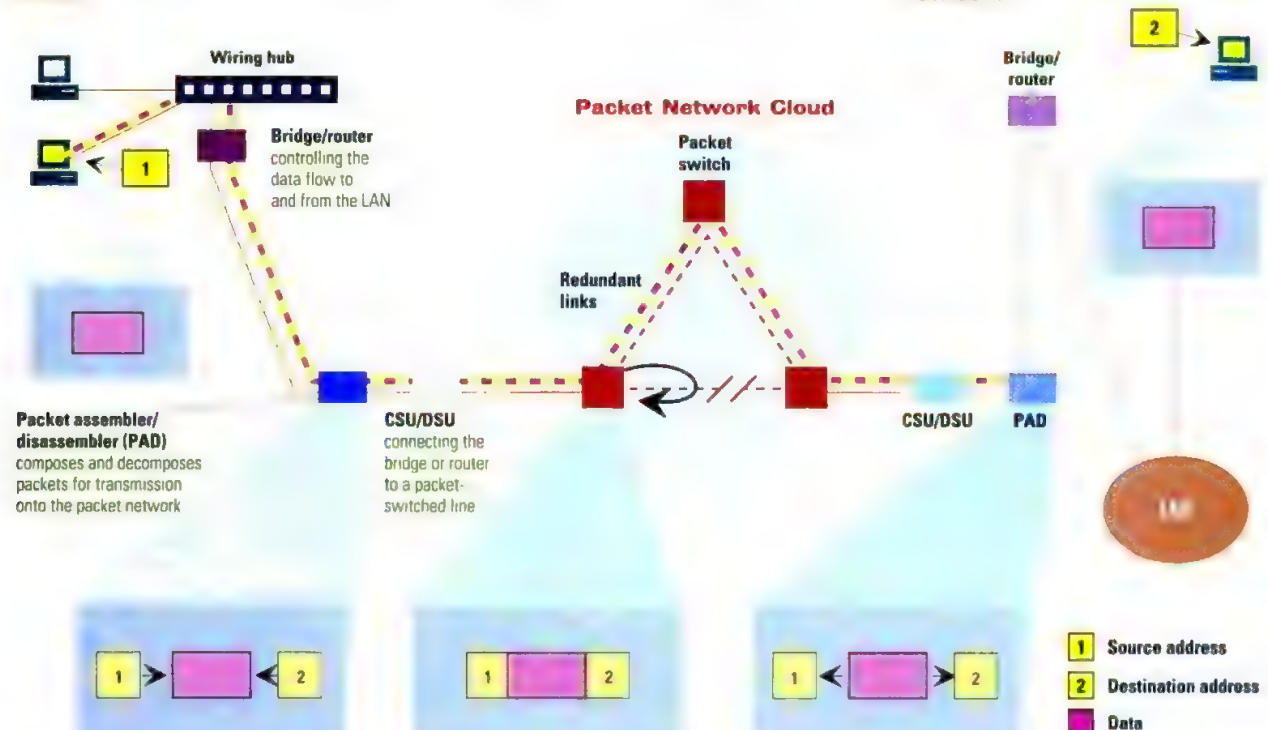
to change the face of local and wide-area networking by introducing economical ways to use the same all-digital technology from the desktop all the way across the long-distance network, with consistent quality and speed.

ATM uses very small packets of a regular size that don't require a great deal of computing power to generate or to route. Because the packets are a regular size, the system need not constantly adjust itself to packets of different sizes. (The packets contain 48 bytes of data and information about the application that created it, and 5 bytes of header information for routing.)

With its standardized packets, ATM technology holds the promise of delivering greater efficiency, better throughput, and more capability than Ethernet or Token-Ring, while needing no major translation for entry into national and international networks. □

Office 1

Office 2



Packet-switched networks use redundant and therefore more reliable links. Here, the network senses a break in the link and reroutes the packet.

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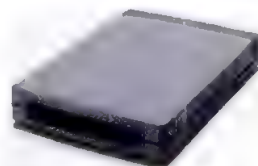
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CIRCLE 323 ON READER SERVICE CARD



from interexchange carriers such as AT&T, MCI, Sprint, Wiltel, or local-exchange carriers. Once again, local phone companies are best if the offices being connected are within the same operating area. If the offices are not in the same operating area, the interexchange carriers are a better bet.

A third group of carriers, called VAN (value-added network) or PDN (public data network) providers, also offer packet-switched services. VANs and PDNs provide a variety of services, ranging from terminal protocol translation (3270 to ANSI terminal, for example) to electronic mail. While interexchange carriers also provide these services, PDNs

such as Advantis, British Telecom's Tymnet, CompuServe, and GE Information Services (GEIS) provide the same connection options with added service.

Packet switching has been more popular in certain areas of Europe and Asia than in the United States because those regions didn't previously have high-quality leased-line or circuit-switched services. In those areas, the packet-switched networks provide a way to share scarce circuits and to ensure the integrity of the data. Still, many companies in North America are finding packet-switched services to be an economical way to connect multiple offices into a single network.

What's more, LANs can connect to the packet-switched network at different speeds (from 56 Kbps to 1.544 Mbps); the network will adjust by buffering the packets. For example, the sending router can dial into CompuServe or MCI Mail at 9.6 Kbps and the receiving router can pull the data off the packet-switched network at 1.544 Mbps. This buffering provides flexibility—you can mix and match wide-area links to suit the purposes of a given installation.

Today, PDN vendors offer X.25 and frame relay services in the United States. While X.25 is popular in Europe, frame relay is just starting to grow. Until 1991, the CCITT X.25 protocol dominated packet-

Pricing the WAN

CIRCUIT-SWITCHED NETWORKS

Circuit-switched network costs are determined by the line speed of the connection, the distance between the LANs, and the amount of usage. We asked several vendors to give pricing schedules for a link between New York City and Foster City, California.

Carrier	Service	Rates	Total cost: New York-Foster City (one 10-minute call)
AT&T	Switched 56	Peak time: first 30 sec., \$0.187; each additional 6 sec., \$0.0214	\$3.02 (plus local-loop costs)
		Off-peak: first 30 sec., \$0.1765; each additional 6 sec., \$0.0193; add \$0.04/min. for each location (peak and off-peak)	\$2.81 (plus local-loop costs)
	Switched T1	First 30 sec., \$4.488; each additional 6 sec., \$0.5136	\$53.28 (plus local-loop costs)
MCI	Switched 56	\$0.07-\$0.22/min.	\$0.70-\$2.20
	Switched T1	First 30 sec. \$2.50-4.30; each additional 6 sec., \$0.20-\$0.43	\$21.50-\$45.15
	Switched T3	First 30 sec., \$37.50-\$64.50; each additional 6 sec., \$3.00-\$6.45	\$322.50-\$677.25
		Information on off-peak MCI rates was not available.	

LEASED-LINE NETWORKS

Leased-line connection rates are usually determined by the line-signaling speed and by the distance between the connected LANs. We asked several vendors of leased-line service to estimate hardware and connection costs for a link between New York and Foster City, California.

Carrier	Service	Rates and requirements	Total cost: New York-Foster City (first month)
AT&T	56 Kbps	Installation charge: \$1,893.69; monthly charge: \$1,903.75; hardware requirements: two Paradyne DSUs (3500 Series 2 units at \$750 each or 3600 series 2 units at \$1,550 each)	\$5,297.44-\$6,897.44
	T1 (1.544 Mbps)	Installation charge: \$4,064.69 (refunded after one year); monthly charge: \$13,206.88; hardware requirements: two Paradyne CSU/DSUs at \$5,300 each	\$27,871.57
MCI	56 Kbps	Installation charge: \$248; monthly charge: \$28.65; \$239 to fix DSU speed; plus \$0.29/mile; hardware cost: no information available	\$1,385.65 plus hardware

PACKET-SWITCHED NETWORKS

Packet-switched network rates are determined by the speed of the connection. We asked several vendors to estimate all costs for a three-way link with nodes in New York, Foster City, California, and Destin, Florida.

Carrier	Service	Rates	Total cost: New York-Foster City-Destin (first month)
InfoNet	56 Kbps	\$1,900/LAN	\$5,700
CompuServe	56 Kbps	Installation charge: \$1,410 (N.Y.), \$1,740 (Calif.), \$2,085 (Fla.); monthly charge: \$645 (N.Y.), \$675 (Calif.), \$1,855 (Fla.)	\$8,410

switched networks worldwide. X.25 uses a conservative, belt-and-suspenders design to ensure the delivery and accuracy of data shipped across the network. But networks using reliable digital circuits don't need all of the accounting and checking provided by the X.25 protocols, so designers stripped off many X.25 functions, thus reducing the overhead. From what was left, they created frame relay.

An important feature, unique to frame relay, is the use of a committed information rate (CIR). The CIR is an agreement on the maximum amount of data that the network guarantees it will carry for you. Frame relay service companies can total up the CIRs of their clients and plan for adequately sized networks. After you work with your vendor to determine a realistic CIR, ask about the additional cost of surge capacity above that rate. For example, AT&T and MCI both allow a user to surge above the

CIR, but AT&T focuses on the duration of the surge while MCI focuses on the percent of the surge above the CIR in affixing additional charges. You might need surge capability if you occasionally have to back up a lot of data or move big files for a special project.

Standards that define a frame relay dial-in capability are not yet fully in place. They are, however, on the horizon. ANSI and the CCITT adopted frame relay standards in 1991, at which time several vendors offered the first frame relay service intermixed with X.25. Now, newcomers such as MCI Data Communications don't even offer X.25 service. Their focus is on frame relay.

As with leased-line services, almost all of the packet-switched services offer flat-rate billing. MCI and GE also offer usage-sensitive billing; after paying a small monthly service fee, you pay a usage fee based on the number of megabytes of delivered data. VAN providers such as CompuServe, GE Information Services, and Tymnet will integrate the necessary data links of your interLAN connection, so you can place one order and pay one bill. A transcontinental 56-Kbps link can cost around \$1,600 for installation at each site, and monthly charges range between \$500 and \$2,000.

CELL RELAY AND BEYOND

New developments in packet-switched systems center on cell-switching technologies. Because the X.25 packet and the frame relay frame are of variable lengths, the network must constantly adjust the flow and timing of messages. When the data bundles are all the same size, the network designers can tighten up operation, reduce the complexity of the system, and gain efficiency. A technology generally known as cell relay—specifically, an evolving standard called asynchronous-transfer mode (ATM)—has been designed for very heavy data loads.

Transmitted at speeds of 1.544 Mbps to 1.2 Gbps, ATM cells consist of 48 bytes of application information plus 5 bytes for the header. Network equipment can quickly route and move these small, uniform bundles of data. ATM may one day operate over ISDN as a class of services known as BISDN (Broadband ISDN), standardized by the CCITT. ATM tech-

See the Disk Spin.

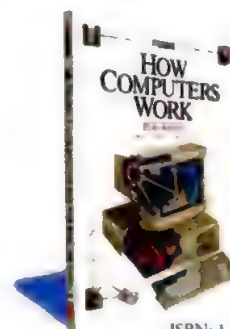


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FACT FILE

Sprint Corp.

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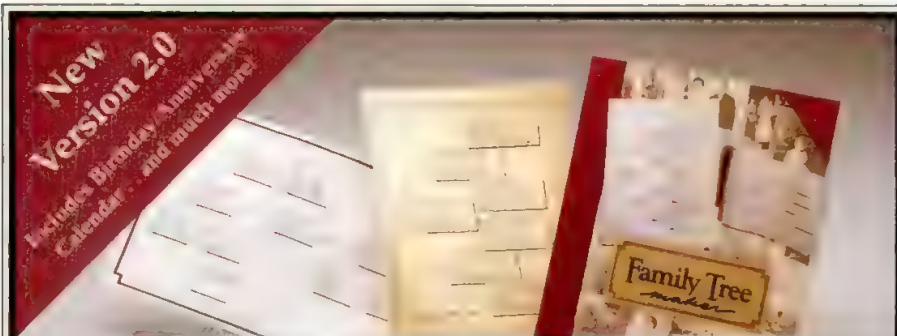
Sprint Corp. is a worldwide vendor of switched digital lines, leased lines, and public data network services—collectively called SprintNet. In the switched digital-service market, Sprint features a service called Bandwidth on Demand, which takes advantage of the flexibility of dialed-up lines to add capacity as needed. Other vendors offer the same capability, commonly called reverse multiplexing. The company offers Sprint Clearline Private Line Services at speeds up to 45 Mbps.

SprintNet provides X.25 and frame relay services throughout the United States. Frame relay service is now available in the United Kingdom, and Sprint plans to deploy frame relay in an additional 23 countries in 1993. SprintNet X.25 service is available in more than 30 countries. SprintNet offers Switched 56 dial-up digital access to the frame relay network.

SprintNet offers several options for connecting LANs. SprintLink is a SprintNet TCP/IP subnetwork, so if you already use TCP/IP routers you can simplify your network operation by using TCP/IP connections. Sprint already has its first ATM customer and the company intends to aggressively market ATM services.

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NETWORKING

Wide-Area Networks

nology will have a substantial impact on networking on all levels in the mid-1990s because it carries the data from the desktop, across the LAN, and across the long-distance link without major changes in how the data transferred by applications is broken into segments for transmission. This results in less handling, fewer errors, and greater efficiency.

Setting up interLAN links will challenge you, but neither ordering nor administering your linked LANs should overwhelm you. The first call for help should always be to the business office of your local telephone company. In many cases, you should also call one or more of the interexchange carriers or public data network providers to see what alternatives they can provide. Buying LAN-to-LAN links is a research-intensive process. Plan ahead, call for help, and compare the responses. □

FACT FILE

Williams Telecommunications Group (WilTel)

One Williams Center, P.O. Box 21348,
Tulsa, OK 74121; 800-642-2299,
918-588-3210, 918-588-5116

You probably haven't heard much about the Williams Telecommunications Group (WilTel), but it is the fourth largest U.S. interexchange carrier, after AT&T, MCI, and Sprint. The company started doing business as a carrier's carrier; it has a nationwide fiber-optic network, and it primarily sold 45-megabits-per-second channels on that network to other carriers. But in March of 1991, WilTel became the first public vendor of frame relay services, and now the company offers a full line of switched digital services and leased lines as well. WilTel focuses on major accounts in the continental United States. It specializes in putting together total network-service packages, from system consulting to equipment installation and the long-distance service.

WilTel's frame relay service, WilPak, is sold at a monthly rate that is not usage sensitive. The rate is based on the speed of service and the cost of access lines. The company offers a 120-day service warranty; if you aren't happy with the service, WilTel will pay the costs of restoring you to your previous service.

If you need LAN-to-LAN connections of any type within the continental United States, WilTel is a good solution. The company is aggressive and offers comprehensive service

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NetWare Compat. (NCP Sup.)	No	No	No	Yes
Unlimited Toll Free Tech Sup.	No	No	No	Yes
Intel Auto Config. Ethernet	Yes	No	No	Yes
Money-Back Guarantee	None	None	30 day	45 day
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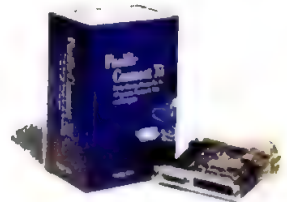
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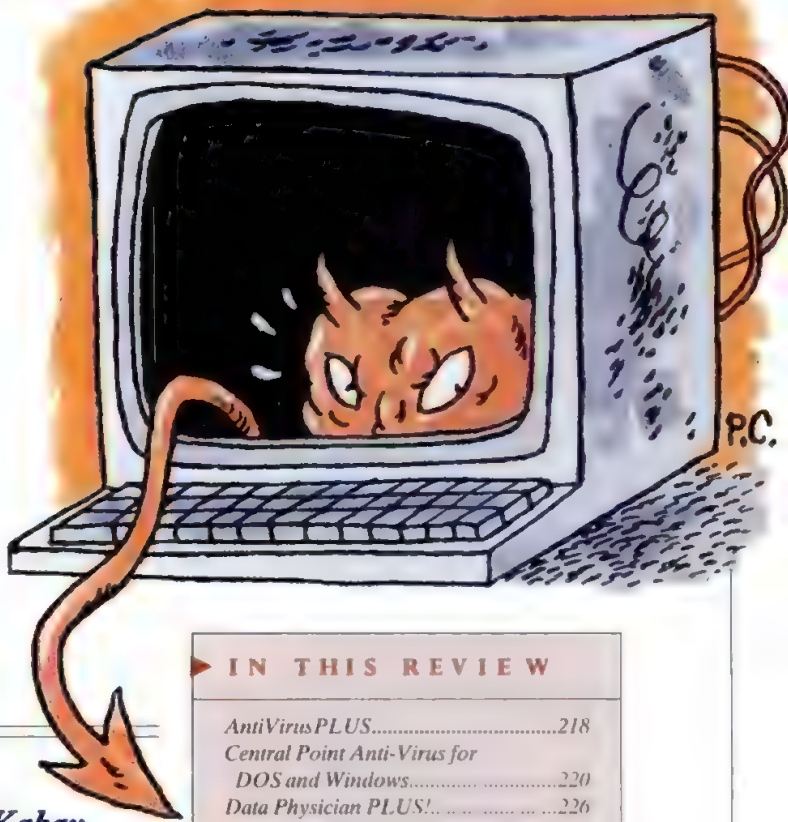


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ANTIVIRUS SOFTWARE

Keeping Up Your Guard

One year after the great Michelangelo scare, viruses, virus creation tools, and antivirus software have gotten smarter and more powerful.



by Robin Raskin with M. E. Kabay

If the Michelangelo virus gave you pause, wait till you see some of this year's breed of stealth and polymorphic viruses. Your first reaction will be a mixture of fear and awe: fear of the sinister threat of these powerful new strains, awe of the ingenuity of their creators. Your second will be an intense nostalgia for the days when computer viruses were merely a nuisance.

If you knew what to look for, you could spot those early viruses fairly easily. Primitive strains such as Lehigh, for example, revealed themselves by changing the modification date on infected files. You could nab other, more evolved viruses, such as Jerusalem or Stoned, by recognizing their *signatures* (unique, identifiable code strings) using a procedure known as signature scanning—rather like spotting Waldo in a crowd by fingerprinting everyone in the picture.

Another giveaway was that infected files inevitably grew in size. Software was developed that recorded the sizes and charac-

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Suitability to Task: Antivirus Software

To be effective in quelling the threat posed by computer viruses, your protection system must fulfill three related missions: It must detect viruses already present on your system, it must remove any viruses it detects, and it must prevent any subsequent infections.

There are several techniques of virus **detection** (no one of which can be considered adequate by itself). The most common is scanning for *signatures* (characteristic, recognizable pieces of virus code). Integrity checking is a class of techniques that compare snapshots of uninfected files with snapshots of current versions, in search of unauthorized changes. Any change to the file, even if it does not alter the file size, will change the snapshot. Most programs immediately notify the user when a change has occurred,

teristics of uninfected files (providing the files were previously scanned and noted as clean), usually with a calculation known as a checksum, and detected infections by comparing recorded sizes with actual file sizes—the procedure known as *integrity checking*.

This year's crop of packages showed some new sophistication in their checksum approaches. Fifth Generation Systems' Untouchable, although it didn't do particularly well on our tests, gathers so much data about the files on your disk that, according to the company, an infected file can be fully reconstructed without the user ever having to know which virus hit.

Knowing where to look was important, too. The earliest viruses used living (that is, executable .COM and .EXE) files as their habitat, becoming active only when those files were called and executed. Later strains learned to live in the boot sectors and partition tables of disks, entering memory and becoming active whenever infected disks were booted.

THAT'S ALL CHANGED NOW

Today's viruses are much more troublesome. Virus authors have figured out ways to camouflage their work. These methods are collectively called *stealth techniques*; the viruses actively hide from antivirus software. Stealth viruses have been arriving in a stream of continuous

SUITABILITY TO TASK				
Product Name				
	POOR	FAIR	GOOD	EXCELLENT
Detection	☒	☐	☐	☐
Removal	☒	☒	☐	☐
Prevention	☒	☒	☒	☐
Removal	☒	☒	☒	☒
Prevention	N/A			

N/A—Not applicable: The product does not perform this task.

but a few use the snapshot only as an indicator that the file should be investigated for possible infection. Still other detection methods search the system for signs of viral activity. These days, most products use a combination of detection methods.

Detection is relatively useless without virus **removal**—putting the virus out of action. Some products restore infected files to health by extracting the

innovation. The first move toward stealth was to avoid changing the modification date of infected files. Next, viruses appeared that trapped the internal procedures (called *interrupts*) the system uses to get information about files. By capturing these interrupts, the viruses could mask their presence by subtracting their own size from the file size before passing the information to the DIR or CHKDSK command. Stealth strains such as FroDo (alias 4096), the one used on our tests, work this way.

Companion viruses, such as Twin-351, which was also used on our tests, manage to live as separate but totally hidden files. These are just two of many stealth techniques.

Just as threatening as stealth viruses are the *polymorphic viruses*, which mutate and change form as they replicate. Some polymorphics can randomly vary their code, switching the sequence of instructions without altering functionality, thus changing their signatures. Other polymorphics encrypt their signatures. During execution, the unencrypted stub

viral code. Some "kill" the virus (render it inoperable) but leave harmless residual code behind. Other packages' designers contend that the only way to remove a virus from an infected disk properly is to delete the file completely. The user is left with the task of restoring the file from original disks or a backup.

The ultimate goal of antivirus software is **prevention**—making sure that no virus ever reaches your system. The most popular approach to this task involves a device driver or TSR that monitors the system continuously for infected files and attempted viruslike activities, scans floppy disks for viral code, and the like. A program should at least be able to identify a virus when the user attempts to execute an infected program. Some packages go beyond this and can prevent a virus-infected file from entering the system when a file is being copied or extracted from a compressed file. A device driver can be loaded before any other application but, unlike a TSR, cannot be unloaded from memory.

of the virus decrypts the rest of the code as it loads into memory.

MASS-PRODUCED VIRUSES

We might take comfort in the hope that very few aspiring virus authors are clever enough to create successful polymorphics. Alas, the Dark Avenger Mutation Engine (or DAME, a polymorphic encryption engine believed to have come from Bulgaria) is available to virtually anyone: The author simply attaches the engine to his or her virus, and it spawns hundreds of different forms with every execution.

And thanks to the arrival of do-it-yourself virus-development kits, today anyone can play at being a virus author. The Phalcon/Skism Mass-Produced Code Generator, the Virus Construction Set, and the Virus Construction Laboratory all allow novice virus authors to generate new viruses in minutes. The Virus Construction Laboratory even sports an attractive graphical user interface, complete with mouse support, pull-down menus, and context-sensitive help.

Our Contributors: ROBIN RASKIN is an executive editor of *PC Magazine*. ANGELA GUNN is a staff editor of *PC Magazine*. THOMAS M. AMOROSO and LAURA COX are support technicians at PC Magazine Labs. STEVEN C. M. CHEN, GREG PASTRICK, and JOHN R. QUAIN are frequent contributors to *PC Magazine*. M. E. KABAY, Ph.D., is the director of education at the National Computer Security Association. TED STEVENSON was the associate editor in charge of this story, and BEN Z. GOTTESMAN was the project leader.

THREE-FINGER EXERCISE

Even as the virus threat escalates, antivirus software rises to meet the challenge. But for full virus protection in the midst of today's cyber-crime wave, you'll need to adopt a three-pronged defense strategy including detection, disinfection, and prevention.

Some software packages, such as Central Point Anti-Virus, are designed to mount all of these defenses; others, such as Panda Pro, concentrate on doing one thing well (in this case, prevention). As long as you have all three fronts covered, it makes no difference whether your protection comes in one box, or two, or three.

DETECTION

Techniques used to spot virus infections still rely primarily on signature scanning and integrity-checking techniques.

The success of scanning generally depends on the completeness and accuracy of the signature library used. As new strains and modifications of familiar viruses proliferate, antivirus software vendors must be constantly on the lookout for them, updating their signature files at regular intervals. It's not enough just to detect the presence of a virus; accurate identification is vital to the disinfection process. These days, most products that include signature scanning make updates available to customers continually.

Another way to detect infection is to look for viruslike code. Rather than scanning for specific virus signatures, "generic" antivirus products—such as NOVI—scan for patterns (such as inappropriate jump instructions) that cannot be masked. Generic products can also watch for abnormal behaviors, such as peculiar system interrupts, thus trapping viruses that use stealth techniques.

Another recent breakthrough is the ability to detect viruses in compressed files. Many packages, such as Fifth Generation's Untouchable and Safetynet's VirusNet, can now scan .ARC and .ZIP formats, for example. So far, they don't do well with the compressed formats used in some vendors' install routines (notably Microsoft Corp.'s).

DISINFECTION

Philosophical debates rage in the community of antivirus vendors on the proper

**EDITORS' CHOICE**

- **Central Point Anti-Virus for DOS and Windows**
- **The Norton AntiVirus**

A view widely expressed in the professional virus-fighting community is that, for the best possible virus protection, one should look not necessarily for a single antivirus product, but for the best signature scanner, the best integrity checker, the best monitoring

package, and so on. Although we conducted our evaluation with this multi-product approach in mind, we concluded that either of our Editors' Choices, Central Point Anti-Virus for DOS and Windows and The Norton AntiVirus, offers protection unsurpassed by any combination we could come up with.

The reality is that virus software developers have made such enormous strides over the past year or two that what was true "yesterday," when inconsistent performance, primitive interfaces, and indecipherable documentation were the rule, has ceased to be true today. In short, the best of today's antivirus software arsenal is effective, easy to use, and unobtrusive.

Reliability is the most important criterion for any antivirus product, but usability and unobtrusiveness are, if you stop to think about it, almost as important. Only the package that actually gets used gets a chance to perform its protective mission; products that are a pain to set up or run and products that interrupt every five minutes with false alarms, demands for user judgments, and the like are likely to end up on the proverbial shelf.

Our two Editors' Choices, Central Point Anti-Virus and The Norton AntiVirus, have played off each other as prime competitors for some time now, with the result that both are solid, well-rounded products with remarkably similar feature sets. Central Point Anti-Virus gets the nod for customizability—which will recommend it to system tweekers—while The Nor-

ton AntiVirus's defaults are so well thought out that users who like to keep things simple can install the program right out of the box with confidence that their systems are getting full protection.

While not quite up to Editors' Choice level this year, former winner NOVI (now owned by Symantec Corp.) deserves an honorable mention for its solid scanning and its excellent TSR, which detects any kind of file modification that could cause damage to your system. It's a very thorough virus fighter without being overly intrusive. Another former Editors' Choice, Dr. Solomon's Anti-Virus Toolkit, remains a strong scanning package, but side by side with today's best competitors, it looks a little outdated, especially its interface.

Interface is not the strong point of Command Software Systems' F-Prot Professional, either, but this \$49 package provides outstanding scanning and virus removal at a bargain price. For this, we mention it honorably, although, by itself, it is by no means a total solution. For that matter, for those comfortable with command line operation, there's no better antivirus bargain than the original F-Prot. It is available *free* to individual users or for \$1 per user (with volume discounts) to business users through America Online, the IBMSYS Forum on CompuServe, and the Public Brand Software Applications Forum on Aiffnet.

For the moment, it looks as if virus software developers are winning their ongoing war with virus authors.

way to disinfect a virus-ridden file or boot sector. While most vendors believe in removing the viral contents of an infected file, others contend that the only safe way to remove a virus is by completely overwriting the file in which it is contained. Both sides make valid points.

For example, a recent accounting turned up 10 aliases (different names) for the Jerusalem virus, 38 viruses in the Jerusalem family (a group of slightly

modified viruses based on the original), and 19 viruses more loosely based on Jerusalem. If, in disinfecting a file, you remove the code for Jerusalem B when the virus actually present is Anarkia-2 (a family member), you will very likely damage the file. On the other hand, although overwriting the file may be foolproof, it doesn't work if you don't have an uninfected original or a backup copy available to restore from.

IBM's AntiVirus uses a combination of both approaches. From any file, it removes viruses comprising code found in its library, and it overwrites files based on these viruses.

PREVENTION

Finally, there are several techniques for detecting viruses *before* they actually infect your system or have a chance to spread, and these techniques are becom-

■ New Wave Virus Busters

by Greg Pastrick

As virus infection becomes a greater threat in all computing environments, developers are finding new solutions in virus-trapping technologies that range from system-level interceptors to telecommunications screeners.

Most virus fighters agree that the floppy disk drive is the primary port of entry for infection, so preventing system boots from floppy disks is a fundamental strategy of many antivirus devices. Many others aim at the more difficult problem of write-protecting the hard disk. Some solutions combine these approaches.

What's needed from the users' perspective is a measure of control over which systems operations are allowed and which are prohibited, without a constant need for minute-to-minute decision making. Controlled access to critical system information and executable files is the compromise antivirus products offer.

SYSTEMIC SOLUTIONS

On the systems level, boot-virus-prevention solutions include a number of BIOS systems, such as AMI's Hi-Flex BIOS, that function as boot-sector monitors and restrict write-access attempts with an alert to the user.

Ergo Computing also takes a BIOS-based approach, building virus protection into the foundations of its systems. The Ergo BIOS (due out in the first quarter of 1993) uses Absolute Control of the Environment and Restoration

Technology (ACERT), working in tandem with encrypted cyclic redundancy check (CRC) monitoring software.

Ergo calls this overall solution Seat Belt.

ACERT checks for modifications of your system's master boot record (MBR), system files, and partition tables before the system actually boots up by comparing them with stored images. If any image changes are detected, any extraneous code is destroyed and the files are restored to their original state. ACERT further disables the A: drive, making it impossible to boot from an infected floppy disk.

ANOTHER TACK

Western Digital's approach is a silicon-based solution that intercepts write requests to the hard disk. The company's WD7855 system logic controller creatively co-opts the system management interrupts (SMI) power-management feature built into the latest 386SX, 386DX, and 486 processors.

Built into this controller is generic antivirus technology called Immunizer, which write-protects critical disk areas and executable files. Further, it monitors all write requests for virus-like activity. In action, the WD7855 passes write requests to the disk controller.

SMI, which monitors this in addition to other power-draining components, then triggers the Immunizer software, which checks to see whether or not the request is directed to a protected area on the hard disk. A simple alert prompts you to accept the write request or reboot.

HARDWARE/SOFTWARE SOLUTIONS

Digital Enterprises' V-Card is another novel hardware/software approach to virus protection that's intended to function as a clean-booting solution.

What's unique about the device is that it holds master-boot-record and partition-table data plus 1,280K snapshots of all critical executable files and antivirus

software all in flash ROMs. V-Card can disable floppy disk drives and function as the primary boot device if the hard disk becomes damaged. In action, the device provides a physical barrier between infected files and your hard disk. It also detects and removes virus threats while preventing unauthorized program loading or file deletion on the fly.

The antivirus detection and removal software portion of V-Card is licensed from Netz Computing in Israel. Also included is a file integrity-checking and restoration program.

*If floppy disks are
the prime source
of virus infections,
modem downloads
are most certainly
next in line.*

ing more accurate and less demanding of your system resources than ever. The most prevalent is a TSR, such as the one in The Norton AntiVirus, that constantly monitors your PC for viruslike activity. Most TSRs can scan floppy disks on the fly as they are read into memory, looking for infected files and boot viruses.

Central Point and Untouchable offer the option of storing the checksum database on a floppy disk so the virus can

never get to the checksum file. They also create a "safe" floppy disk that contains a backup of the boot sector and a copy of the antivirus software. You can boot off this disk to scan with absolute assurance that your checksum file is intact.

WHAT WE TESTED

In the quest for solutions, PC Magazine Labs tested 24 antivirus software packages designed primarily for standalone

OTHER HARD CHOICES

Hardware-based virus-security solutions come in other forms as well. Trend Micro Devices, based in Torrance, California, markets its \$139 PC-cillin anti-virus system with a device called the Immunizer Box, which connects to the printer port. This is actually an electrically erasable programmable ROM (EEPROM) chip that stores boot-sector and partition-table contents. While the PC-cillin software intercepts and removes viruses, the critical MBR information is kept safe in the virus-free Immunizer Box, ready for restoration to the hard disk should it become damaged by infection.

Multix markets a hardware solution on an 8-bit card that intercepts or filters I/O activity on the PC bus. Its \$69 Viru-Stop PC Immunizer Card screens system operations before DOS is enabled on boot-up and automatically scans memory and boot sectors for virus-like activity. Following a clean boot, it monitors all data that moves across the bus and suspends operation with an alert if a known or suspected virus infection is found.

A product with a different twist is the C:Cure drive-blocking device from Leprechaun Software International. It's bundled with the company's Virus Buster software in a \$299 package. It connects to the drive cable between the interface card and the hard disk and acts as a virtual write-protection tab that prevents any attempt to write to the C: volume. This method requires that you have at least two partitions on your hard disk, though: one devoted exclusively to critical executable and program files and the other reserved for data files and

nonessential programs. In effect, the C: drive becomes an impregnable fortress with the C:Cure device serving as the locked gate.

While the C:Cure method may be extremely restrictive for most users, it, like many other hardware solutions, has the potential for broad application in many structured computing environments where specific computing tasks built around select applications are the rule. Freestyle computing introduces too many opportunities for system invasions by deadly viruses.

COMING OVER THE LINES

If floppy disks are the prime source of virus infections, modem downloads are next in line. Now, some remote-communications software makers are building specific virus-protection features into their products. The \$199 Close-Up 4.0 from Norton-Lambert includes CRC monitoring as its method of virus screening, and Central Point Software's Commute uses some of the technology from that company's Anti-Virus package to scan files as they're uploaded. The software cuts off file transfer if it detects an infection.

In the real world, there's probably no one solution to virus prevention that fits all computing styles or environments. Where drive lockouts and diskless workstations work for one group, the loss of free access and unmonitored file exchange would have a disruptive effect on the work of another. What's clear is that antivirus technology is rich and varied enough to be applied in combinations that can ensure a high level of security in just about any environment. □

PCs. (While LANs unquestionably pose their own special and important problems as potential mass disseminators of viruses, few of the special products designed to address those problems are ready for prime time. We will discuss them fully in our next antivirus roundup.)

While many of the packages we reviewed claim to catch as many as 2,000 viruses, according to the November 1992 edition of Patricia Hoffman's definitive VSUM database, only 72 viruses are classified as common. Most of the remaining 1,928 or so either have never been seen outside a controlled laboratory setting or were too poorly written to survive in the wild. A few are just new.

Accordingly, PC Labs selected 11 viruses for testing that represent a good cross section of the real-world virus community. Eight of the 11 are taken from the common list; these are the most important ones for antivirus programs to be able to intercept.

Since the vast majority of infections are still caused by signature viruses, this is where we concentrated our efforts. We did, however, include several tests of the polymorphic virus Dedicated, which is based on the Dark Avenger Mutation Engine. We also selected two viruses with stealth capabilities (FroDo and Twin-351). Nine of our test viruses are file infectors; two are boot-sector viruses. For more complete information on the viruses we used and how the products fared, see the performance test charts.

HOW WE TESTED

First, we tested the ability of each package's standalone module to detect and identify the eight file-infecting signature viruses. Using a Compaq Deskpro 386/25e, we ran this test from a write-protected floppy disk after booting the system from a clean floppy (the safest method, since it ensures that viruses will not be resident in memory).

Next, we took ten files infected with Dedicated (our polymorphic virus) and determined whether our packages could detect and identify the virus in each file without reference to its uninfected structure via checksum or another record. We repeated the test after creating a checksum of each uninfected file. Then we tested to see whether the program could

SOFTWARE

Product Media Price

Spreadsheets

- Lotus 1-2-3 Windows 1.1 F5 \$ 315
Item #58836-16
- Lotus 1-2-3 Windows 1.1 F3 \$ 315
Item #61837-16
- Lotus 1-2-3 Windows 1.1 Upgrade F3 \$ 99
Item #54832-16
- Microsoft Excel for Windows 4.0 F3 \$ 299
Item #53253-16
- Microsoft Excel for Windows 4.0 F5 \$ 299
Item #66598-16
- Lotus 1-2-3 2.4 F3 \$ 335
Item #67606-16
- Lotus 1-2-3 2.4 F5 \$ 335
Item #69601-16



Lotus 1-2-3

Word Processing

- WordPerfect 5.2 for Windows F3 \$ 275
Item #77919-19
- WordPerfect 5.2 for Windows F5 \$ 275
Item #80915-19
- Microsoft Word for Windows 2.0b F3 \$ 299
Item #64932-19
- Microsoft Word for Windows 2.0b F5 \$ 299
Item #73937-19

Product Media Price

Word Processing Con't

- Lotus Ami Pro 3.0 Dual \$ 265
Item #55236-19
- Lotus Ami Pro 3.0 Upgrade Dual \$ 99
Item #32259-19

Database

- Borland Paradox 4.0 F3 \$ 499
Item #63329-08
- Borland Paradox 4.0 F5 \$ 499
Item #63325-08
- Borland Paradox 4.0 Upgrade F3 \$ 189
Item #89829-08
- Borland Paradox 4.0 Upgrade F5 \$ 189
Item #91828-08
- DataEase Express F3 \$ 149
Item #85902-11
- Symantec Q&A 4.0 F3 \$ 249
Item #95743-13
- Symantec Q&A 4.0 F5 \$ 249
Item #17461-13

Presentations/Graphics

- Lotus Freelance Graphics for Windows F3 \$ 339
Item #29190-10
- Lotus Freelance Graphics for Windows F5 \$ 339
Item #21199-10
- Harvard Graphics for Windows 1.01 F3 \$ 359
Item #37744-10
- Harvard Graphics for Windows 1.01 F5 \$ 359
Item #89734-10
- Microsoft PowerPoint 3.0 F3 \$ 299
Item #12531-03
- Microsoft PowerPoint 3.0 F5 \$ 299
Item #82528-03
- Aldus Persuasion 2.1 F3 \$ 327
Item #77993-03
- Aldus Persuasion 2.1 F5 \$ 327
Item #83997-03
- Spinnaker PFS: Publisher for Windows F3 \$ 89
Item #38927-04

Product Media Price

Integrated

- Lotus SmartSuite F3 \$ 459
Item #71818-13
- Lotus SmartSuite F5 \$ 459
Item #73818-13
- Microsoft Office 3.0 F3 \$ 459
Item #36837-13
- Microsoft Office 3.0 F5 \$ 459
Item #49836-13
- Spinnaker PFS: WindowWorks 2.0 F3 \$ 78
Item #40941-13

General

- Chipssoft TurboTax for Windows Headstart Dual \$ 49
Item #73918-02
- Chipssoft TurboTax for DOS Headstart Dual \$ 49
Item #00635-02
- Intuit Quicken 6.0 Dual \$ 39
Item #79785-02
- Intuit Quicken for Windows 2.0 Dual \$ 29
Item #45870-02
- Intuit Quickbooks Dual \$ 89
Item #38392-02
- IBM OS/2 2.0 F5 \$ 145
Item #23449-17
- IBM OS/2 2.0 F3 \$ 145
Item #26442-17
- Symantec Norton Desktop for Windows 2.0 F3 \$ 109
Item #88164-11

Product Media Price

General Con't

- Symantec Norton Desktop for Windows 2.0 F5 \$ 109
Item #63129-11
- Quarterdeck QEMM 386 F3 \$ 59
Item #45010-17
- Quarterdeck QEMM 386 F5 \$ 59
Item #42019-17

PERIPHERALS AND ACCESSORIES

Multimedia

- Creative Labs Multimedia Upgrade Kit Int \$ 549
Item #30738-25
- Creative Labs Sound Blaster Pro Int \$ 199
Item #61991-54
- MediaVision Pro 16 Multimedia System Int \$ 899
Item #23507-54
- MediaVision Multimedia Upgrade Kit Plus Int \$ 735
Item #38504-54
- MediaVision Fusion 16 Multimedia Upgrade Kit Int \$ 509
Item #88934-25
- MediaVision Pro Audio Spectrum 16 Int \$ 199
Item #01507-54



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Product	Media	Price
Modems		
Cardinal Technologies 2400 w/Prodigy Kit Item #000666-41	Int	\$ 39
Practical Peripherals 2400 SA 9600Fax Item #55492-41	Ext	\$ 109
Practical Peripherals 9600 SA w/QuickLink II Item #17710-41	Ext	\$ 305
Hayes Optima 96/Smartcard EZ 32/42BIS Item #60063-41	Ext	\$ 359
Cardinal MB14400 V.32 w/Turbofax V.42 Item #40355-41	Ext	\$ 309



Sound Blaster Pro

Monitors		
NEC Multisync 3FGX Item #55195-23	\$ 689	
NEC Multisync 4FG Item #75319-23	\$ 799	
Radius PrecisionColor Display 19 Item #89497-23	\$2,229	
Dell UltraScan 14C Item #320-3364	\$ 449	
Dell UltraScan 15FS Item #320-3369	\$ 549	

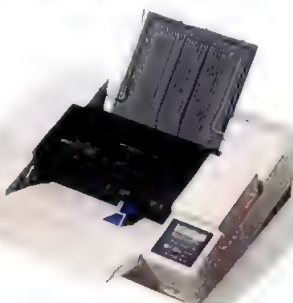
Printers		
IBM/Lexmark Personal Printer II 9Pin 80Col Item #99025-27	\$ 367	
IBM/Lexmark Personal Printer II 24Pin 80Col Item #87025-27	\$ 355	
Epson AP-3250 Item #330-1482	\$ 209	
Canon BJ-10 Ink Jet Item #72069-28	\$ 329	
IBM/Lexmark Color Jetprinter 4079 LJ item #12993-28	\$2,749	
IBM/Lexmark 4070 LJ Item #79832-28	\$ 385	
Epson EPL-8000 Item #330-3347	\$1,159	

Printers Can't		
IBM/Lexmark 4019 Laser Printer Item #79641-37	\$ 875	
Genicom Model 7170 Item #12844-37	\$3,215	
Okidata OL400P LED Page Printer Item #70695-37	\$ 649	
Texas Instruments Microlaser Basic Item #13399-37	\$ 899	
Texas Instruments Microlaser PS17 Item #12814-37	\$1,215	

Storage		
Quantum Prodrive ELS 85MB IDE Item #03731-34	Int	\$ 225
Quantum Prodrive ELS 127MB IDE Item #09734-34	Int	\$ 295
Quantum Prodrive ELS 170MB IDE Item #16736-34	Int	\$ 335
Conner Soft-Stor 3170 Item #76828-34	Int	\$ 565
Colorado Jumbo 250 DJ-20 Item #88977-26	Int	\$ 274

Product	Media	Price
Storage Can't		
Imomega Tape 250 Insider Halfheight Item #35848-34	Int	\$ 249

Networking		
Artisoft Lantastic Windows Utility 4.1 Item #20664-36	Dual	\$ 179
Artisoft Lantastic Starter Kit 4.1 Item #89634-36	Dual	\$ 509
Novell Netware Lite 1.1 Item #02829-36	F5	\$ 59
Novell Netware Lite 1.1 Item #01827-36	F3	\$ 59
Windows for Workgroups Item #13151-17	F5	\$ 162
Windows for Workgroups Item #13166-17	F3	\$ 162
SMC Ethercard +Elite 16 Combo Item #23477-36	Int	\$ 198
SMC Ethercard +Elite 16T Item #11544-36	Int	\$ 145
IBM Token Ring 16/4 Item #89733-36	Int	\$ 549



Lexmark Model 4079 Color Jet Printer

Input Devices		
Logitech Mouseman Cordless Serial PS/2 Item #62063-35	\$ 89	
Logitech Mouseman Serial PS/2 RH Item #75010-35	\$ 69	
Microsoft Mouse-Bus Item #81453-35	\$ 99	
Microsoft BallPoint Mouse w/Windows 3.1 Item #55034-35	F3	\$ 159
Logitech Scanman Model 256 Item #46485-53	\$ 275	
The Complete PC Complete Page Scanner w/OCR Item #41725-53	\$ 549	



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Performance Tests: Antivirus Software

The standalone scanners in 13 of the 24 packages we saw detected every virus in our test suite, but only F-Prot Professional was able to disinfect each file accurately. All but one of the programs have TSRs that constantly monitor system activity to detect attempted infections. Only three of these TSRs stopped every virus.

THE VIRUSES

PC Magazine Labs tested each package with 11 different viruses. Nine viruses infect files, and two infect the boot sector of a floppy or a hard disk. Ten viruses have a *signature* (a known string of bytes), and one, Dedicated, is a polymorphic virus, which changes its appearance each time it infects a file.

Although it is most important that antivirus software detect common viruses, ideally the programs should also

be able to detect viruses encountered less frequently. Eight of our test viruses are classified as common. The three comparatively rare viruses were Dedicated, Mummy 1.2, and Twin-351.

All but Dedicated are memory-resident and infect new files as you work on your system. Dedicated infects up to

four .COM files in the current directory when an infected file is executed, then removes itself from memory.

The test suite also included two viruses, FroDo and Twin-351, that use stealth techniques to avoid detection. Twin-351 is a "companion" virus. It creates a new hidden file containing the

VIRUS PREVENTION (using memory-resident module)

Detection of attempted file infections

	File-infecting signature viruses				
	Cascade-1704 (.COM)	Dark Avenger (.COM)	Dark Avenger (.EXE)	FroDo (.COM)	FroDo (.EXE)
✓ = Disinfected the file — = Did not detect the virus					
AntiVirusPLUS	✓	✓	✓	✓	✓
Central Point Anti-Virus for DOS and Windows	✓	✓	✓	✓	✓
Data Physician PLUS!	✓	✓	✓	✓	✓
Detect Plus	✓	✓	✓	✓	✓
Dr. Solomon's Anti-Virus Toolkit	✓	✓	✓	✓	✓
F-Prot Professional	✓	✓	✓	✓	✓
IBM AntiVirus	✓	✓	✓	✓	✓
InocuLAN/PC	✓	✓	✓	✓	✓
The Norton AntiVirus	✓	✓	✓	✓	✓
NOVI	✓	✓	✓	✓	✓
Panda Pro*	✓	✓	✓	✓	✓
PC Rx	—	✓	✓	✓	✓
Pro-Scan*	✓	✓	✓	✓	✓
Untouchable	✓	✓	✓	✓	✓
Vaccine	✓	—	—	—	—
Victor Charlie	N/A	N/A	N/A	N/A	N/A
Virex for the PC	✓	✓	✓	✓	✓
VirusCide Plus	✓	✓	✓	✓	✓
VirusSafe	—	✓	✓	✓	✓
Virus Alert	✓	✓	✓	✓	✓
Virus Buster	✓	✓	✓	✓	✓
VirusCure Plus	✓	—	✓	✓	✓
VirusNet	✓	✓	✓	✓	✓
Vi-Spy Professional	✓	✓	✓	✓	✓

N/A—Not applicable. The program does not provide for real-time virus protection. * This program can detect a virus only if a checksum of the uninfected file

VIRUS DETECTION AND REMOVAL (using standalone module)

✓ = Disinfected the file
D = Deleted, moved, or renamed the corrupted file
F = Failed to remove detected virus
— = Did not detect the virus

File-infecting signature viruses

	Cascade-1704 (.COM)	Dark Avenger (.COM)	Dark Avenger (.EXE)	FroDo (.COM)	FroDo (.EXE)	Green Caterpillar (.COM)	Jerusalem (.COM)
AntiVirusPLUS	✓	✓	✓	✓	✓	✓	✓
Central Point Anti-Virus for DOS and Windows	✓	✓	✓	✓	✓	F	✓
Data Physician PLUS!	✓	✓	—	✓	✓	—	✓
Detect Plus	✓	✓	—	✓	✓	—	✓
Dr. Solomon's Anti-Virus Toolkit	✓	✓	✓	✓	✓	✓	✓
F-Prot Professional	✓	✓	✓	✓	✓	✓	✓
IBM AntiVirus	✓	D	D	✓	✓	D	✓
InocuLAN/PC	✓	✓	✓	✓	✓	✓	✓
The Norton AntiVirus	✓	✓	✓	✓	✓	✓	✓
NOVI	✓	D	D	✓	✓	✓	✓
Panda Pro	D	D	D	D	D	D	D
PC Rx	✓	✓	✓	✓	✓	D	✓
Pro-Scan	✓	✓	✓	✓	✓	✓	✓
Untouchable	✓	✓	✓	✓	✓	✓	✓
Vaccine	D	D	D	D	D	D	D
Victor Charlie	D	D	D	D	D	—	D
Virex for the PC	✓	D	D	✓	✓	D	✓
VirusCide Plus	✓	✓	✓	✓	✓	✓	✓
VirusSafe	✓	✓	✓	✓	✓	✓	✓
Virus Alert	✓	✓	✓	✓	✓	✓	✓
Virus Buster	F	✓	✓	✓	✓	✓	✓
VirusCure Plus	✓	✓	✓	✓	✓	✓	F
VirusNet	✓	✓	✓	✓	✓	✓	✓
Vi-Spy Professional	✓	✓	✓	✓	✓	D	✓

* Deletion is the proper disinfection method for Twin-351 ** This program detected nine out of ten files containing the Dedicated virus

viral code rather than appending the code to an existing file.

WHAT WE SAW

Predictably, programs that use the same engines produced similar test results.

The standalone modules of Data Physician PLUS! and Detect Plus missed the same three viruses. F-Prot Professional,

Virus Alert, and VirusNet (all based on Fridrick Skulason's F-Prot shareware program) detected all the test viruses. F-Prot Professional has checksumming, which enabled it to remove Dedicated; only four programs could do this.

The virus prevention TSRs of Panda Pro and Pro-Scan can detect viruses only if a checksum of the uninfected file

exists. Further, these programs warn you of a new virus only after infection has occurred, a less than ideal situation.

Programs that were able to detect, remove, and prevent the common viruses will provide you adequate protection today. Those able to handle the new polymorphic and stealth viruses will carry you farther into the future.

							Detection of infected disks		
							Polymorphic virus	Boot-sector signature virus	
Green Caterpillar (COM)	Jerusalem (COM)	Jerusalem (EXE)	Mummy 1.2 (EXE)	Twin-351 (EXE)	Yankee Doodle (COM)	Yankee Doodle (EXE)	Dedicated (COM)	Michelangelo (floppy disk)	Michelangelo (hard disk)
✓	✓	✓	✓	✓	✓	✓	—	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	—	✓	✓	✓	✓	✓	✓
✓	✓	✓	—	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	—	✓	✓
✓	✓	✓	✓	✓	✓	✓	—	—	✓
✓	✓	✓	—	✓	✓	✓	—	—	✓
✓	✓	✓	✓	—	✓	✓	—	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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✓	✓	✓	—	✓	✓	✓	—	—	✓
✓	—	✓	✓	✓	✓	✓	—	—	✓
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✓	✓	✓	—	✓	✓	✓	✓	—	—
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
✓	✓	✓	—	—	✓	✓	—	✓	✓
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✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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✓	✓	✓	—	—	✓	✓	—	✓	✓

					Polymorphic virus	Boot-sector signature viruses			
Jerusalem (EXE)	Mummy 1.2 (EXE)	Twin-351* (EXE)	Yankee Doodle (COM)	Yankee Doodle (EXE)	Dedicated (COM)	Michelangelo (floppy disk)	Michelangelo (hard disk)	Stoned (floppy disk)	Stoned (hard disk)
✓	D	D	✓	✓	D	✓	✓	✓	✓
✓	✓	D	✓	✓	✓	✓	✓	✓	✓
✓	—	D	✓	✓	D	✓	✓	✓	✓
✓	—	D	✓	✓	D	✓	✓	✓	✓
✓	✓	D	✓	✓	✓	✓	✓	✓	✓
✓	D	D	✓	✓	D	✓	✓	✓	✓
✓	—	D	✓	✓	—	✓	✓	✓	✓
✓	✓	D	D	D	D	✓	✓	✓	✓
✓	—	D	✓	✓	D	✓	✓	✓	✓
D	D	F	D	D	D	—	✓	—	✓
✓	✓	D	D	✓	D**	✓	✓	✓	✓
✓	F	F	✓	✓	D	✓	✓	✓	✓
✓	D	D	D	D	C	✓	✓	✓	✓
D	—	D	D	D	D	F	F	F	F
D	—	—	D	D	D	F	✓	F	✓
✓	—	D	✓	✓	✓	✓	✓	✓	✓
✓	—	D	✓	✓	✓	✓	✓	✓	✓
✓	✓	D	✓	✓	D	✓	✓	✓	✓
✓	✓	D	F	F	D	✓	✓	✓	✓
✓	—	—	D	—	—	✓	✓	✓	✓
✓	✓	D	✓	✓	D	✓	✓	✓	✓
✓	—	D	✓	✓	D	✓	✓	✓	✓
✓	—	D	✓	✓	D	✓	✓	✓	✓

SOFTWARE
Antivirus Software

detect our two boot-sector viruses, both on an infected floppy disk and on the hard disk.

Whenever the software succeeded in detecting a virus, we attempted to remove it, verifying the disinfected file by checking the file's size and time/date stamp, by executing the program, and by scanning with another antivirus product known to be able to identify the virus.

PHYSICIAN, HEAL THYSELF

Should it become infected, an antivirus package can be an extremely dangerous carrier, spreading the virus to each and every file on which it operates. To test each program's built-in infection safeguards, we infected standalone products, device drivers, and TSRs with the stealth virus FroDo to see if they were able to detect the infection and take appropriate action.

In a separate group of tests, we put the virus-prevention memory modules (TSRs and device drivers) through their paces in order to determine whether they could detect virus-infected files as they were being executed, copied, or unzipped from a compressed file. We also determined whether these TSRs could detect a boot-sector virus on hard and floppy disks.

THE INTRUSIVENESS ISSUE

As we carried out our tests, we became aware of an important factor unrelated to questions of the depth and reliability of virus protection: Some antivirus products appear to be designed to do their job at all costs—regardless of how they intrude on users' work habits. The problem, of course, is that many people simply won't use a product that frequently interrupts them with false alarms or instructions to scan or makes it cumbersome to move or copy files. You should keep this in mind as you peruse the following reviews in search of the perfect antivirus product.

In the ongoing battle between virus creators and antivirus vendors, it is difficult to tell who is winning at any given time. This new generation of viruses is certainly not to be taken lightly, but with any one of today's better antivirus software products on the job, there is no need to panic.

T.C.P. Techmar Computer Products Inc.

AntiVirusPLUS

BY STEVEN C. M. CHEN

The \$99.95 AntiVirusPLUS from T.C.P. Techmar Computer Products is a good virus prevention and detection package, but it falls short when it comes to integrity checking.

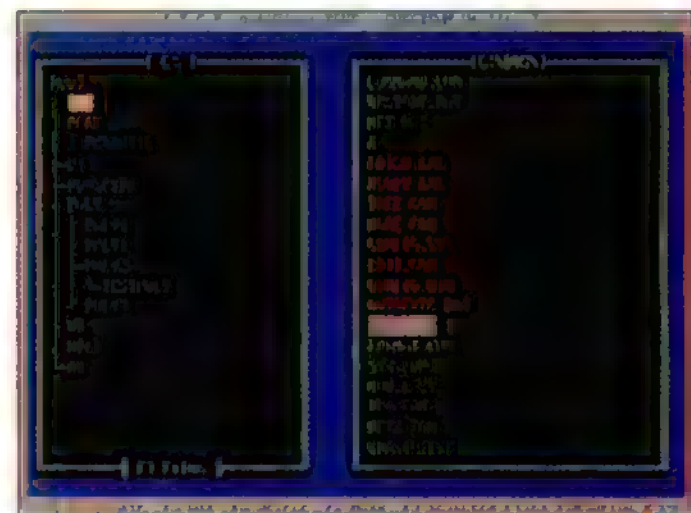
The easy installation gives you the option of creating an emergency backup disk that includes copies of critical system areas, such as the complementary metal-oxide semiconductor (CMOS). The installation program will, optionally, rewrite the AUTO-EXEC.BAT files to load EXAMINE—the scanning program—and two terminate and stay resident (TSR) programs.

EXAMINE checks several system areas, such as the hard disk partition table, compares them with the backup signature files created during installation, and restores them if necessary.

AN OUNCE OF...

Prevention is handled by two memory-resident programs, PREVENT1 and IMMUNE2, which, together, take up about 32K of RAM. PREVENT1 monitors memory for suspicious virus activity independent of any specific virus signature. IMMUNE2's job is to prevent virus-infected files from loading. In PC Labs' tests, IMMUNE2 stopped most of our virus-infected files from executing, only failing to detect files infected with the Dedicated virus. IMMUNE2 also correctly warned us that our test floppy disk was infected with a boot-sector virus. IMMUNE2 cannot scan compressed files, however, nor files being decompressed or copied.

AntiVirusPLUS also includes a standalone scanner called CURE. The CURE interface consists of a simple pull-down menu that contains all the switching options, such as drive selection, and files specifications to scan (.EXE, .COM), in addition to on-line, context-sensitive help.



AntiVirusPLUS's menu option offers no easy way to select files directly by drive or directory.

CURE performed well on the PC Labs tests. It detected all virus-infected files. It was unable, however, to disinfect files carrying the Mummy virus and recommended instead that the files be deleted. The same also applied to Dedicated, a polymorphic virus.

CURE does its job well, but its on-screen report function is not as extensive as it should be. While accurately identifying viruses, it does not provide details such as the directory location and description of the virus functions.

FOUND WANTING

AntiVirusPLUS's integrity-checking feature, CS (for checksum), is not particularly strong. The information it provides is limited, and it only detects changes in the first line of the file code. For example, if a program has been deleted, CS will only report that a file has been modified.

The manual is on the thin side and covers only the basics. The list price doesn't cover any software upgrades or virus-

► FACT FILE

AntiVirusPLUS, Version 4.20.09

*T.C.P. Techmar Computer Products Inc.,
98-11 Queens Blvd., Rego Park, NY 11374;
800-922-0015, 718-997-6666;
fax, 718-520-0170*

List price: \$99.95.

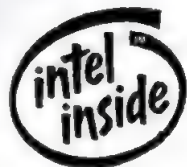
Requires: 256K RAM, 256K hard disk space, DOS 3.0 or later.

In short: AntiVirusPLUS offers good virus prevention and detection. Its installation program is exceptional in its ability to create an emergency safe disk.



ON READER SERVICE CARD

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CIRCLE 353 ON READER SERVICE CARD

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Antivirus Software

SUITABILITY TO TASK

AntiVirusPLUS

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	○

signature library updates. They are available for \$29 per item.

AntiVirusPLUS could be a first-rate package if the checksum feature were revamped and better integrated with the scanner program. Otherwise, AntiVirusPLUS is a package that does decent virus protection.

Central Point Software Inc.

Central Point Anti-Virus for DOS and Windows

BY GREG PASTRICK

Central Point Anti-Virus, which costs \$129, is clearly one of the most full-featured and well-designed antivirus packages available. Its fast, automated operations give you a high level of protection with only a minimum of system interference and a sophisticated response appropriate to the level of virus threat. This package comes ready to work in the DOS, Microsoft Windows, and Novell network environments. Anti-Virus is also included in Central Point's \$179 PC Tools Version 8.0.

Anti-Virus offers two installation options: quick install and custom install. In either case, the software runs a complete virus scan-and-removal cycle before loading itself on the hard disk. The



SUITABILITY TO TASK

Central Point Anti-Virus for DOS and Windows

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	●

quick install option uses the program's default protection. These include setting the system to run BootSafe (a master boot-record protection utility), creating a Microsoft Windows program group, loading the terminate and stay resident (TSR) manager if

Windows is present, and loading the VSafe TSR virus monitor.

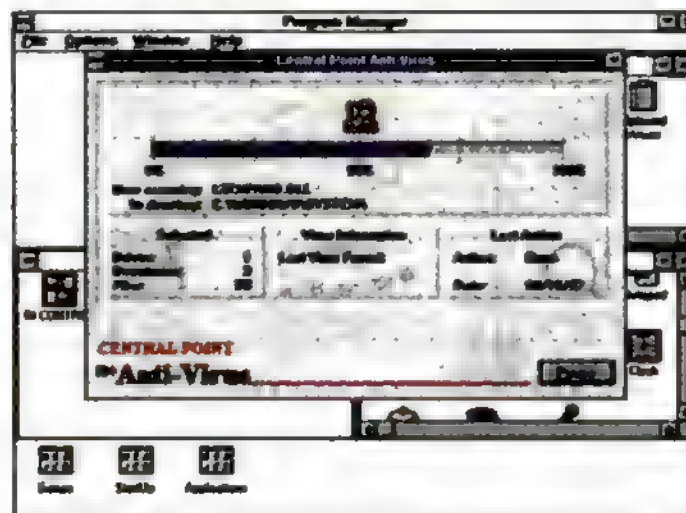
The custom install option takes you through a series of options panels for altering AUTOEXEC.BAT, setting the VSafe protection features, and defining the general program settings. Whichever installation routine you choose, the program creates file-integrity checklist files on all subdirectories scanned and makes a hidden boot-sector file (BOOT.CPS) in the root directory.

A SOLID CENTER

The well-designed and informative interface gives you several operation options. Antivirus activities may be launched from the full menus on the main interface, from function key assignments detailed along the bottom of the screens, or via the Express Menu. The last gives you quick detect, clean, and scan operations without the detail and distraction of the full menus. Interactive, context-sensitive help windows may be accessed from any of the interface screens.

Central Point Anti-Virus is flexible enough to allow virus detection and removal from the command line while suppressing the graphic interface and names of the files scanned for fast, unobtrusive scans. Regardless of how you run it, the scanner will automatically remove infected files or hide potentially damaging files it finds. When it encounters infected files it's not sure of, it will either delete them or rename them with harmless extensions (such as .VOM for COM files).

In our tests, Anti-Virus had trouble with a file it detected as being infected with the Twin-351 virus. In response, it launched a report recommending that a



The Windows version of Central Point Anti-Virus scans all files critical to Windows' operations.

copy of the infected file be physically sent to the Central Point headquarters for analysis and virus removal. The product was also unable to properly disinfect a file infected with Green Caterpillar.

A full year's worth of quarterly virus signature

updates is available for \$79.95 or can be pulled monthly from the Central Point BBS on CompuServe for an additional log-on charge.

OTHER HIGHLIGHTS

The software's file-integrity modules work interactively with either the VWatch low-level TSR virus monitor, which searches for known viruses, or VSafe, which gives you the highest level of protection, but takes up 22.2K of RAM. Checking file integrity or creating new checksums is as easy as enabling the features in the general settings dialog box. File immunization is an active option from both the interface menus and direct from the command line. Logging of all program activity may be easily directed to screen, printer, or full reports.

Though virus removal is largely transparent to the user, the program is careful to alert you to threats it can't effectively handle on its own by giving you options



FACT FILE

Central Point Anti-Virus for DOS and Windows, Version 1.4

Central Point Software Inc., 15220 NW Greenbrier Pkwy., #200, Beaverton, OR 97006; 800-445-4208, 503-690-8090

List price: \$129.

Requires: 640K RAM, 1MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.0 or later.

In short: The features and performance of Central Point Anti-Virus for DOS and Windows are impressive. No wonder a stripped-down version of the program was chosen to be included in DOS 6.0.



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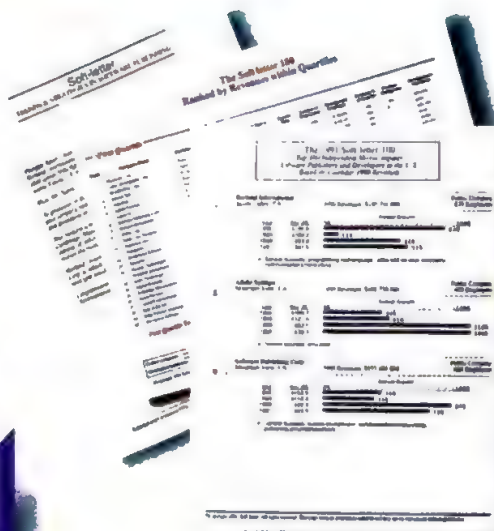
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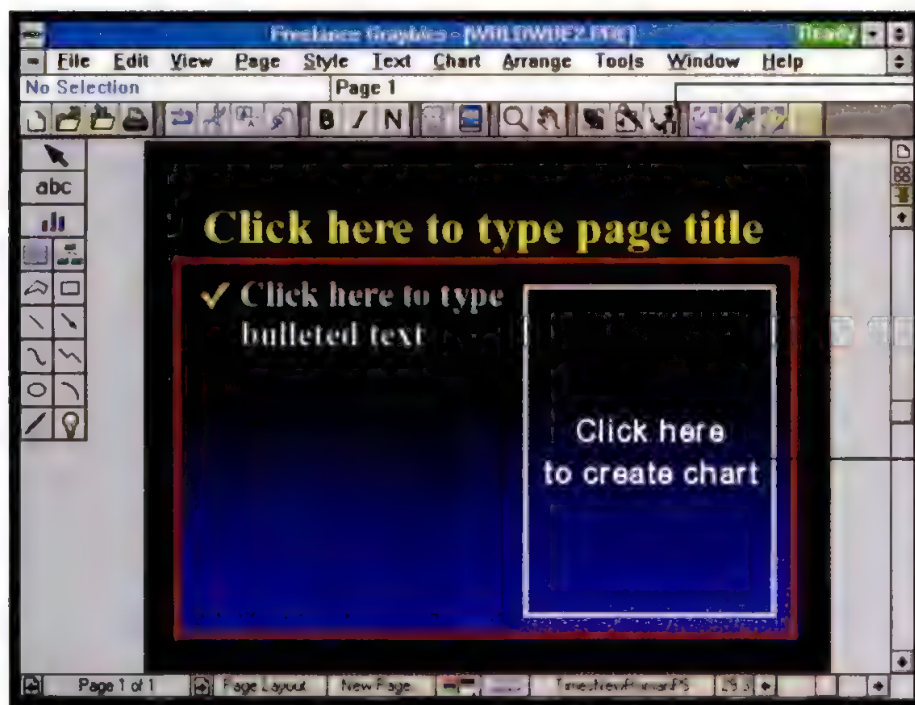
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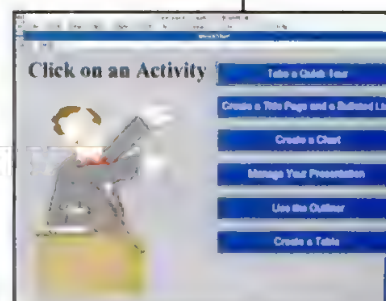
CIRCLE 315 ON READER SERVICE CARD

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(Especially the decision t



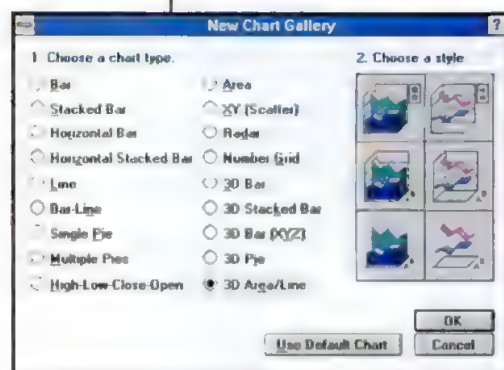
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Freelance 2.0

Presentation Graphics for Windows

to reconstruct or remove damaged or questionable files it finds.

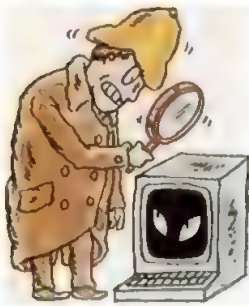
Anti-Virus's design, execution, and flexible operations certainly make it one of the most comprehensive virus-protection packages you can buy. Central Point has just released a version designed specifically for Windows 3.1: It puts a smartly optimized interface on the same virus-monitoring, detection, and removal capabilities found in this version.

Digital Dispatch Inc.

Data Physician PLUS!

BY STEVEN C. M. CHEN

Data Physician PLUS! 3.1B (\$49), from Digital Dispatch, has features that are not



found even in some more expensive packages. These include such amenities as a TSR that can scan for viruses and perform integrity checks.

Unfortunately, the above-average TSR is paired with a merely average scanner.

NO SURPRISES

Data Physician offers a typical installation program. In addition to installing, upgrading the AUTOEXEC.BAT file, and optionally creating a rescue floppy, it generates a checksum database that is used by both the TSR and the standalone program. A nice added touch is that the installation program can create a batch file with the proper switches for either the standalone or the TSR.

Data Physician's TSR, RESSCAN (both the DOS-only and Windows-aware versions are included), offers double protection. In addition to scanning for viruses before files are executed or copied, it also performs an integrity check. A virus may be able to

FACT FILE

Data Physician PLUS!, Version 3.1B

Digital Dispatch Inc., 55 Lakeland Shores Rd., Lakeland, MN 55043; 800-221-8091, 612-436-1000; fax, 612-436-2085

List price: \$49.

Requires: 384K RAM, 435K hard disk space, DOS 2.0 or later.

In short: Data Physician PLUS! provides good features at a low price. The TSR offers double detection: scanning and integrity checking. The ANTIGEN inoculation utility performs a self-check before programs are executed.



ON READER SERVICE CARD

escape the initial detection, but the integrity check should spot any changes.

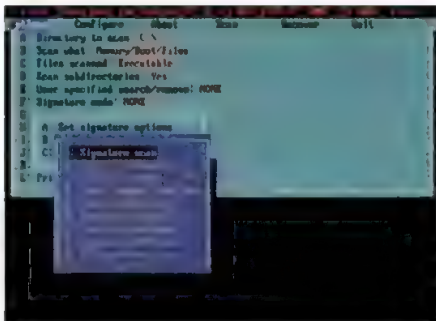
RESSCAN's performance is almost flawless: Files infected with a rare strain of the Mummy virus were the only ones that escaped detection. When RESSCAN detects a virus, you have the option to continue, stop, or reboot. One drawback is that RESSCAN requires 36K of RAM, significantly more than most of the other antivirus TSRs require.

THE HUNTER

Like the TSR, the main program, VIRHUNT, can also pull double duty as both a scanner and integrity checker. In our tests, VIRHUNT detected all but three virus-infected files. The package's reporting functions could use some improvement: You can't review reports on screen. Nor does the program warn you when it can't successfully remove a virus. Files infected with the polymorphic Dedicated virus, for example, were simply

deleted without a warning.

Another level of protection can be added for executable files (.COM and .EXE) with ANTIGEN. This utility attaches a "security prefix" to every selected file which performs a self-check before files are loaded, disa-



With Data Physician PLUS!, you can scan files in many ways. Just remember that "NO signature scan" means scanning with a virus-signature library.

SUITABILITY TO TASK

Data Physician PLUS!

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	○	○
Removal	●	●	●	○
Prevention	●	●	●	○

bling viruses when it detects them. Unlike a full-time TSR, ANTIGEN doesn't prevent virus attacks; it simply warns you if a file has been altered. But then it doesn't eat up RAM like a TSR does. ANTIGEN works only with DOS-based applications and increases the size of each by about 3K (.COM files) or 5K (.EXE files).

Data Physician offers a Custom Intercept Language that allows you to add new virus information, but this is strictly for programmers—advanced programmers.

While the product could certainly use a few improvements, such as better scanning and reporting, Data Physician PLUS! is a generally fine product that offers good antivirus performance at a low price.

Commcraft Inc.

Detect Plus

BY STEVEN C. M. CHEN

Detect Plus, Version 2.11, from Commcraft, takes a multiple-utilities approach in the fight against viruses. What's missing is a centralized menu. Instead, each utility has its own interface. Detect Plus offers average virus prevention and detection. At \$129, the product is priced on the high side, unless you buy more than 100 copies. Detect Plus uses scanning technology from Digital Dispatch, the maker of Data Physician PLUS! (also reviewed here).

Unlike most other antivirus installation routines, Detect Plus's doesn't auto-

SUITABILITY TO TASK

Detect Plus

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	○	○
Removal	●	●	●	○
Prevention	●	●	●	○

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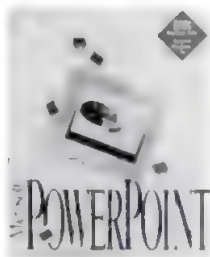
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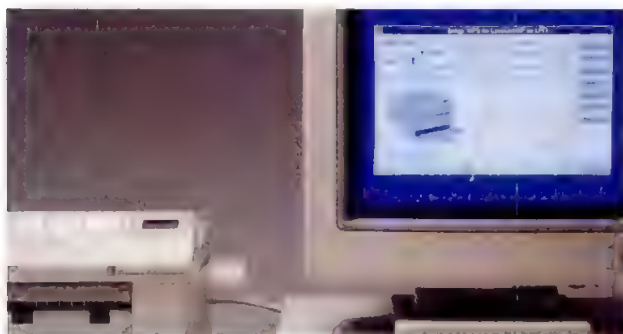


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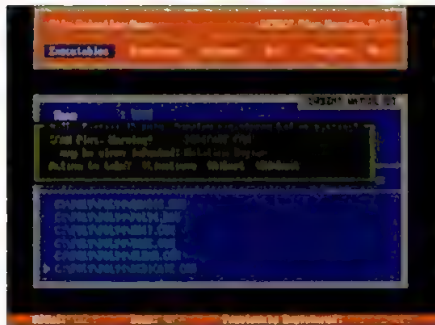
Antivirus Software

matically check the system for viruses; whether you want it to is up to you. If a virus is detected, you must reboot. The installation will modify your AUTOEXEC.BAT automatically or leave the decision to do so to you.

IN THE FOXHOLE

The Scan Plus (SP) scanning TSR requires about 27K of RAM. When SP detects a virus, it doesn't automatically stop the program from executing. Instead, a warning message pops up giving you the option to continue, abort, or reboot the system. (A Windows-compatible version of the TSR is also included.) On our tests, SP stopped all infected files except for those carrying the Mummy virus. SP didn't detect infections in compressed files during decompression, but it was able to detect viruses during DOS COPY or XCOPY operations.

Virus Search and Destroy (VSD), the scanner, has basic pull-down menus. In addition to identifying viruses by name, it also gives description and behavior patterns. Reports can be saved to disk. VSD



Detect Plus's memory resident program checks files for viruses.

polymorphic Dedicated virus.

DETECTIVE

Detect Plus (DP) is the integrity-checking utility that checks the system files (such as COMMAND.COM), reporting changes in file date, time, size, or contents. On our tests, DP accurately reported changes only in files that were infected but didn't confirm virus damage. To get more information, we had to scan the files with VSD. If you run DP while the TSR is running in the background, however, and if the TSR detects a virus, you will get a warning message.

A unique feature of DP is Watchlists, which can be composed to include executable and nonexecutable files you might want to keep under security watch for any reason whatever. You can create as many as you want.

The manual we received is out of date, but it will be updated by the time you read this. For now, we had to use the included update and read-me files to address all the changes.

If you're considering purchasing fewer than 100 copies, there are other antivirus packages that offer stronger virus prevention and detection.

Panda Systems

Panda Pro

BY ANGELA GUNN

Panda Pro, Version 5.1, a \$79.95 suite of utilities from Panda Systems, approaches data protection from a very singular point of view. "Give us a clean machine," it

can optionally create a rescue disk that includes the hard disk boot record and CMOS. On PC Labs' tests, files infected with the Green Caterpillar and Mummy viruses went undetected. VSD also failed to detect 1 of the 10 files that were infected with the

FACT FILE

Panda Pro, Version 5.1

Panda Systems, 801 Wilson Rd.,
Wilmington, DE 19803; 800-727-2632,
302-764-4722; fax, 302-764-6186

List price: \$79.95.

Requires: 256K RAM, 110K hard disk space, DOS 2.0 or later.

In short: Panda Pro, which combines a virus-activity scanner with workstation security utilities, won't cure your machine of the virus it has now, but the program will keep the next one from striking. It is an interesting tool for network administrators and features good technical support.

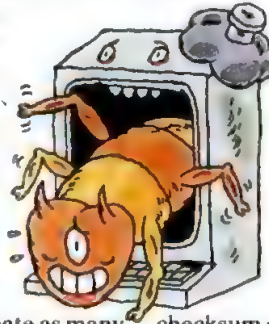
ON READER SERVICE CARD

promises, "and we'll make sure you never have an infection."

Panda Pro's utilities can warn users of any change to program files. In fact, the BEARTRAP utility can lock a system down so thoroughly that a user cannot load new executable files without permission. Obviously, Panda Systems is aiming at the network-administration market; with minimal virus-scanning and no removal features, the company's watchwords are clearly preventive maintenance.

Installation is a breeze; Panda Pro develops a file-checksum database (in which you may set search parameters) and puts a guard on your boot sector. But the machine must be virus-free; installation halts if a virus-like string is detected, and no removal functions are available. Administrators may configure individual workstations to search their files at boot-up or on-the-fly, or they may set the program to show end-users service warnings rather than the usual scan results.

Installation is friendly, since the pack-



FACT FILE

Detect Plus, Version 2.11

Commcraft Inc., 10000 Virginia Manor Rd.,
#300, Beltsville, MD 20705; 800-334-8338,
301-470-2500; fax, 301-470-2507

List price: \$129.

Requires: 512K RAM, 1MB hard disk space, DOS 2.1 or later.

In short: Commcraft's Detect Plus, Version 2.11, offers average virus prevention at a fairly hefty price. Like other programs in this roundup, Detect Plus uses separate scanner and integrity-checking utilities to deal with viruses, but it doesn't have a master shell for all of the utilities.

ON READER SERVICE CARD

SUITABILITY TO TASK

Panda Pro

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	○	○
Removal	●	●	○	○
Prevention	●	●	○	○

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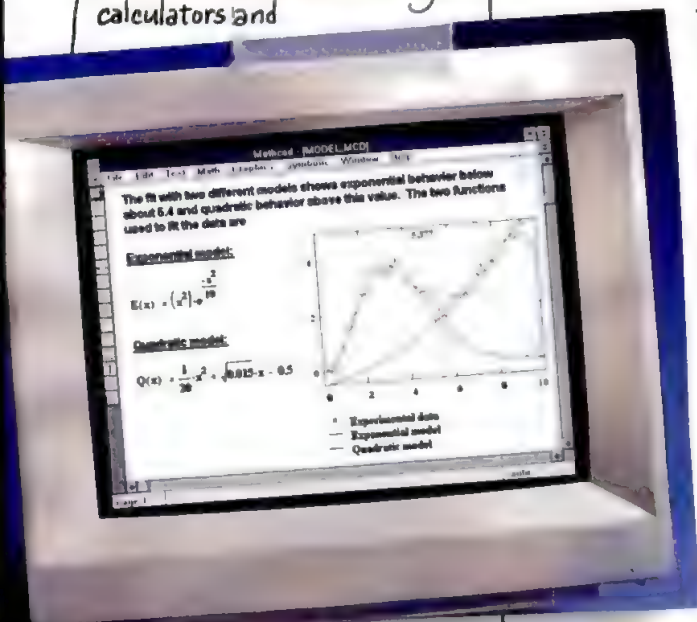
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CIRCLE 154 ON READER SERVICE CARD

age doesn't modify files on its own. The well-written documentation helps when configuring individual installations.

JUST PREVENT IT

Its minimal scanning and integrity-checking features aside, Panda Pro concentrates its efforts on prevention. If you don't choose to regulate your system closely, you must keep the TSR loaded and religiously update the database. We were able to wreak merry havoc on systems that weren't carefully administered; in one case, we managed to infect the scan program itself and thoroughly hang the machine. The package detected its own infection but was powerless against it.

If your machine stands alone, Panda Pro is not your product. Look elsewhere, also, if your setup isn't already pure. But administrators wishing to prevent, rather than discover, viruses may want to give this package a try.

Ontrack Computer Systems Inc.

Dr. Solomon's Anti-Virus Toolkit

BY JOHN R. QUAIN

A former *PC Magazine* Editors' Choice, Dr. Solomon's Anti-Virus Toolkit (\$150) has maintained its stalwart antivirus performance. Unfortunately, with Version 5.0, it has also retained its awkward interface and buried menu command options.

Dr. Solomon's relies on three basic antivirus defenses: a virus signature scanner, a monitoring TSR, and a file checksum database. The program's scanner looks for virus signatures, checking entire files. Though it can be set to check all files, it cannot detect viruses in compressed files.

FIRST DEFENSE

The TSR portion of Dr. Solomon's,

FACT FILE

Dr. Solomon's Anti-Virus Toolkit, Version 5.0

Ontrack Computer Systems Inc., 6321 Bury Dr., #15-19, Eden Prairie, MN 55346; 800-752-1333, 612-937-1107; fax, 612-937-5815

List price: \$150.

Requires: 268K RAM, 764K hard disk space, DOS 2.1 or later.

In short: Though Dr. Solomon's Anti-Virus Toolkit 5.0 is a sturdy antivirus package with in-depth documentation, its interface leaves a lot to be desired. Individual users may be happier with the Microsoft Windows version of the program.



ON READER SERVICE CARD

which takes up about 5.5K of memory, can be set to check files on execution, copies, reads, and writes. Selecting all four parameters may slow down your work, however. The TSR can also be set to monitor conventional, upper, expanded, or extended memory—although not simultaneously.

Unfortunately, the TSR looks only for known viruses and doesn't monitor DOS interrupts for virus-like activity. This prevents false alarms from frightening users but means some virus activity may be overlooked.

In scanning tests, Dr. Solomon's successfully caught all the viruses on PC Labs' tests. Its TSR also managed to recognize every virus we threw at it and proved resilient in its ability to clean almost all viruses. The exception was the polymorphic virus Dedicated. When Dr. Solomon's can't successfully remove the infection (as it was unable to do with the Dedicated virus), it either renames the file to prevent its execution or it deletes the entire file altogether.

Dr. Solomon's has an abstruse pull-down menu and submenu commands that may prompt you to resort to the documentation. Once you do, however, you'll find the man-

ual thorough, albeit unattractively organized. There are, for example, 252 pages devoted to describing various viruses, their effects, and techniques for their removal.

NET SUM

Although there is no network-specific package available from Ontrack, Version 6.0 of Dr. Solomon's should include network-messaging capabilities. The updated version also has a second "certify" TSR that creates updated checksums. New versions are also available for Microsoft Windows (\$195) and OS/2 (\$195), but these were not ready in time for testing.

Informal tests of the preliminary Windows version proved it to be one of the more flexible, attractive, and easier to follow of the Windows packages; it is certainly superior to its DOS progenitor. It also includes a scheduler, though you can

SUITABILITY TO TASK

Dr. Solomon's Anti-Virus Toolkit

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	○

only set specific times, rather than days, for scanning and repair.

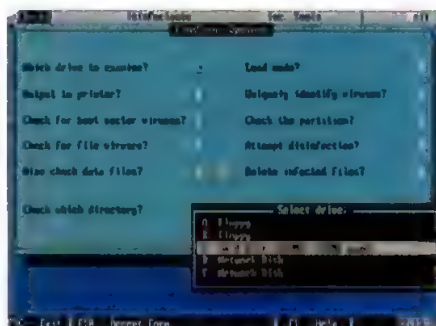
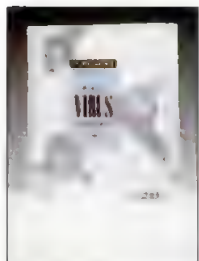
Dr. Solomon's may not be the easiest program to get along with, but information system managers will appreciate its varied parameter settings and thorough documentation. Single users who don't want to learn everything they were afraid to ask about viruses will probably be happier either with one of the simpler packages or with the Microsoft Windows version of Dr. Solomon's.

Command Software Systems

F-Prot Professional

BY GREG PASTRICK

Frisk Software International's shareware product, F-Prot, has developed a credible reputation as an able and accurate program for virus scanning, disinfection, and protection. At \$1 a copy (plus connect time and download fees), it is definitely



Dr. Solomon's Anti-Virus Toolkit's interface doesn't equal those of some competing products, yet it still provides powerful virus detection options.

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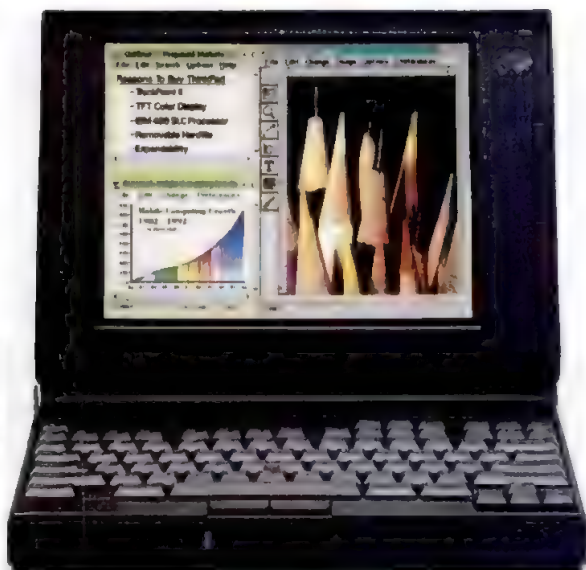


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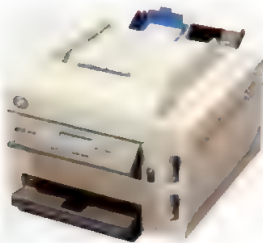
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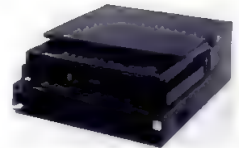
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CIRCLE 066 ON READER SERVICE CARD

an antivirus bargain. But it lacks boot-sector and partition-table restoration, file integrity-checking, comprehensive documentation, and technical support. Enter Command Software Systems and its agreement with Frisk Software to publish an improved \$49 shrink-wrapped version called F-Prot Professional. Picking up where the shareware leaves off, F-Prot Professional adds master boot record protection and CRC (cyclic redundancy check) features, plus a simple but effective interface.

You can run F-Prot Professional directly from the command line or its full-menu interface. Automatic installation of the software to hard disk is an option initiated from the program interface only. The install routine merely copies the program files to a subdirectory on your hard disk, allows editing of a virus alert message, and prompts you for auto-insertion of the virus monitoring TSR line (VIR-STOP.EXE) to AUTOEXEC.BAT.

WHAT YOU SEE

In our review copy of F-Prot Professional 2.06a, the file-integrity feature, CRC.EXE, was not an integrated element of the software, though it will be for all versions of the program beyond the current one.

The interface menu's scan option incorporates all essential command line switches. By default, it initiates a quick scan of the standard executable files on the hard disk and reports any viruslike findings. You can easily set scans options in a pop-up menu that includes the method (quick, secure, or heuristic), the search location (drive, directory, file, or disk), the action to be taken (automatic or queried infection deletion and disinfection), the kind of virus to look for (boot, file, packed, and Trojan), and the type of files to scan (all, executable files, or user-defined).

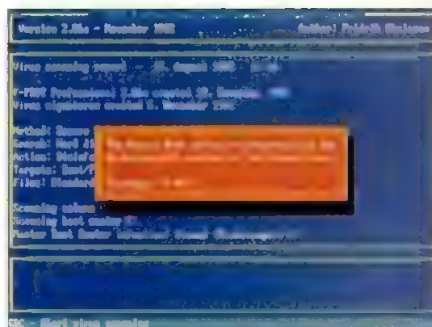
All activity is logged on screen with options to direct the report to a file or to the printer. From the command line, you may send the report directly to a named file. Signature updates are available either monthly via BBS download or quarterly from Command Software Systems at a price of \$1

F-Prot Professional always performs an initial memory and boot-sector scan for known virus infection before running its quick and efficient, predefined scanning and disinfection routines. F-Prot Professional uses signature and Trojan-definition files, and you gain an additional layer of protection from the CRC utility now packaged with the program.

MORE PROTECTION

Like the scanning portion of F-Prot

Professional, the CRC program is supported by a TSR (CRCSTOP.EXE) that monitors file modifications on the fly, once you have initialized the database holding the file information used for restoration. In addition, the CRC utility has



F-Prot Professional's interface and virus alert messages are direct and to the point. The program outputs all scanning activities to the screen.

SUITABILITY TO TASK				
F-Prot Professional				
	POOR	FAIR	GOOD	EXCELLENT
Detection				
Removal				
Prevention				

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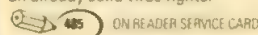
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Requires: 384K RAM, 400K hard disk space, DOS 2.1 or later

In short: With this version, F-Prot Professional makes the move away from well-regarded shareware product to full-featured retail antivirus solution. It's affordable, efficient, and reliable. New CRC capabilities enhance an already solid virus fighter.



switches for checking, cleaning, listing, updating, and deleting files that are contained in the database. You can insert a line in AUTOEXEC.BAT to have the program automatically check files in the CRC list at boot-up.

Overall, Command Software Systems' F-Prot Pro-

essional, Version 2.06a, is a robust and intelligent virus fighter that is well worth its retail price. The product can serve as a frontline defense against infection, as well as a backup to other antivirus software or hardware solutions. Command Software Systems brings enhanced marketing and support to F-Prot Professional while Frisk Software continues to develop it.

Cheyenne Software Inc.

Инициализация

BY LAURA COX

Cheyenne Software's approach to fighting viruses is twofold: It offers both network and standalone products. InocuLAN, a NetWare Loadable Module (NLM) for NetWare Version 3.x (or a value-added process — VAP — for NetWare Version 2.x), scans files accessed on the server. InocuLAN/PC, the program's new workstation-based counterpart, is a \$49 standalone package that successfully defeated every virus in our tests without getting in our way.

Installation offers single users the ability to run InocLAN/PC's preventive terminate and stay resident programs (TSRs) at system start-up by adding them to AUTOEXEC.BAT or from the command line. (If you're logging on to a network and the Enforcement option is enabled on the host, you will be forced to load at least one of the TSRs.) Critical



Antivirus Software

disk information (including copies of the boot sector, partition table, and system files) is automatically saved to the hard disk, and can also be saved to a rescue disk.

SCANNER

InocuLAN is at its most effective when all of its TSRs are installed and running, but the IMMUNE signature scanner marks the product's strongest line of defense. Upon start-up, InocuLAN/PC checks the first 640K of memory (1MB if you specify) as well as itself for viruses. The IMMUNE signature scanner will check specified drives using either its entire signature library or a portion of the library containing the most common virus signatures. Users can run the scanner from the command line or easily set scan preferences from within InocuLAN/PC's menu-driven, mouse-supported interface. And since the interface was developed with Solution Systems' C-Worthy programming utility, it resembles many of Novell's own utilities, making NetWare users feel right at home.

InocuLAN/PC successfully detected and removed all but one of the signature viruses in our scan tests, ignoring only a rare strain of the Mummy virus, which it later detected with its TSRs fully loaded.



InocuLAN/PC gives users the choice of curing, removing, renaming, or deleting infected files with a C-worthy interface.

check accessed files for virus signatures and virus-like behavior, thus omitting excessive false alarms. The trick is, you have to use them. When loaded in memory, PREVENT was able to stop the polymorphic Dedicated virus from entering the system. However, when PREVENT was loaded on an infected system, it didn't know a virus existed, allowing the system to be further infected.

With all of its defenses in place, InocuLAN/PC was able to detect all 13 of our test viruses. It detected the Twin virus, but couldn't prevent the virus from further infecting the system. Although InocuLAN/PC allowed all of the infected files to be unzipped, it caught the viruses it was aware of upon execution. InocuLAN/PC cures, deletes, renames, or moves infected files, and in the case of suspected boot viruses, will restore the boot sector.

Cheyenne offers free signature updates, which registered users can download from their BBS service.

If your plans include future enterprise-wide protection, but you want to fight viruses now, InocuLAN/PC is more than half a step in the right direction. By the time you read this, InocuLAN/PC should have a new version available. Although we were unable to test it, the package will reportedly fill many of the minor gaps reported here.

An activity log reports all scan activities and can be saved to disk for future reference.

A DIFFERENT SUM

Instead of creating a checksum for each executable file on your system, InocuLAN/PC utilizes its two TSRs, called IMMUNE and PREVENT, to

Symantec Corp.

The Norton AntiVirus

BY JOHN R. QUAIN

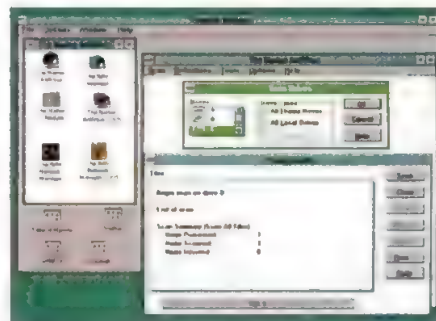
One of the first true Microsoft Windows antivirus programs on the market, The Norton AntiVirus (\$129), from Symantec Corp., has a reputation for being a sophisticated yet easy-to-manage package. On *PC Magazine's* tests, it lived up to its promise.

Symantec packs both DOS and Windows versions into Release 2.1 of The Norton AntiVirus. All of the same features can be found in both versions, except the automatic scheduler, which is available only to Windows users.



NICE FACES

Both versions also offer handsome interfaces, rivaled in this regard only by Central Point Software's entry. You'll never



The Windows version of The Norton AntiVirus couples reliable virus detection tools with a snappy, easy-to-read and easy-to-use graphic interface.

be at a loss to find a parameter or be confused by inscrutable settings and commands.

The Norton AntiVirus includes scanning, monitoring, and repair capabilities. A full Windows installation requires about 1.4MB of disk space and will automatically make a rescue disk with CMOS, partition table, and boot-sector information stored off-line. During installation, The Norton AntiVirus automatically creates checksum files using a proprietary CRC algorithm. The checksum database is encrypted and hidden.

FACT FILE

InocuLAN/PC, Version 1.1

Cheyenne Software Inc., 55 Bryant Ave.,
Roslyn, NY 11576; 516-484-5110;
fax, 516-484-3493

List price: \$49

Requires: 400K RAM, 775K hard disk space, DOS 3.0 or later

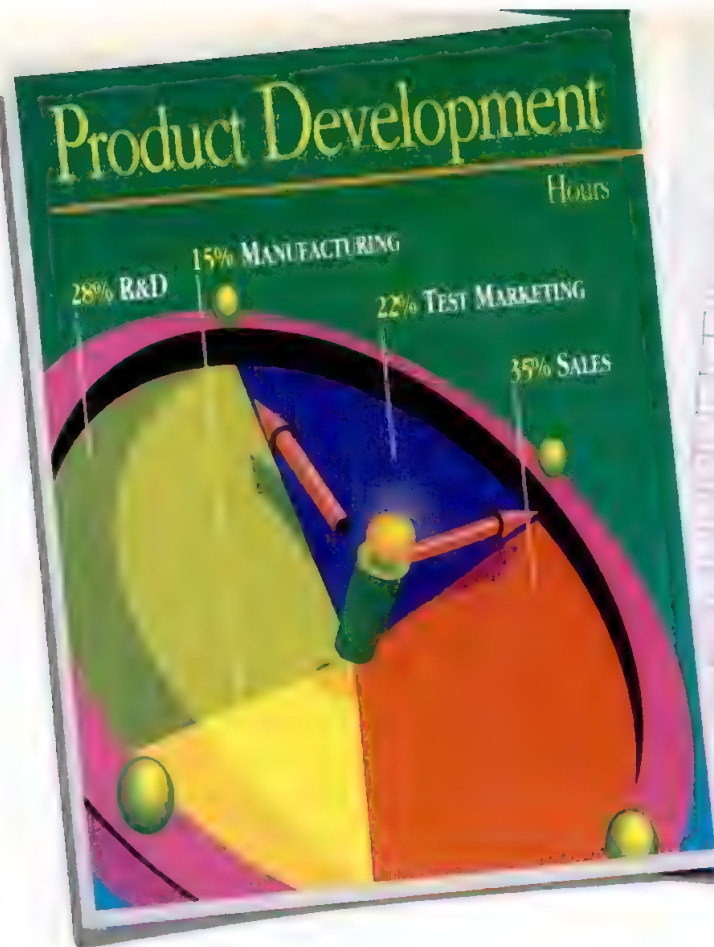
In short: Cheyenne Software's InocuLAN/PC, with its familiar C-Worthy interface, is easy to use and will peacefully and diligently protect your system from known and unknown viruses. Users who plan on future enterprise-wide protection will benefit the most from this package.

468 CAN READER SERVICE CARD

SUITABILITY TO TASK

InocuLAN/PC

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	○	○
Removal	●	●	●	○
Prevention	●	●	○	○



UNITED HEALTHCARE PURCHASE REQUISITION

12-10 *Jim*

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	✓ Adobe PS Level 2	

APPROVED

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X

2011

Jim

\$3,695⁰⁰

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Tektronix

SOFTWARE

Antivirus Software

SUITABILITY TO TASK

The Norton AntiVirus

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	●

As an extra line of defense, The Norton AntiVirus's TSR will prevent the checksum database from being altered. The TSR can be configured to provide varying degrees of protection, taking from 2.3K to a whopping 56K. Fully armed, the monitor will provide complete write protection for boot and partition tables on hard disks and floppies. On PC Magazine Labs' tests, The Norton AntiVirus's TSR not only warned of impending infections (and offered the option of proceeding), but actually prevented file access outright in some cases, such as with the Dark Avenger and Jerusalem strains.

About the only feature that we found lacking in The Norton AntiVirus 2.1 was the ability to scan compressed files. On our tests, the program could not repair a file that was infected with the Yankee Doodle virus. As with all but five of the other packages that we tested, The Norton AntiVirus couldn't repair files that were infected by the polymorphic virus Dedicated. In such cases, the program deletes the infected file, of course making it unrecoverable, so that there's no danger of reinfection.

WHAT'S NEW

The improvements made to Version 2.1 over Version 2.0 involve the package's network abilities. Although no NLM version is available for NetWare, The Norton AntiVirus is compatible with LAN Manager, LANTastic, NetWare, and VINES networks. The improved capabilities include automatic updates at login and manager-selectable instructions that prevent users from logging on without being scanned first or running The Norton AntiVirus's TSR monitor.

Even though Version 2.1 has been tweaked to scan systems faster than the previous version, it is still considerably slower at scanning memory under Windows than Central Point's package.

Symantec recently acquired Certus International, which makes NOVI, and expects to integrate many of that package's features into The Norton AntiVirus. This may propel The Norton AntiVirus into the spotlight as the most capable anti-virus protection program on the market.

Symantec Corp.

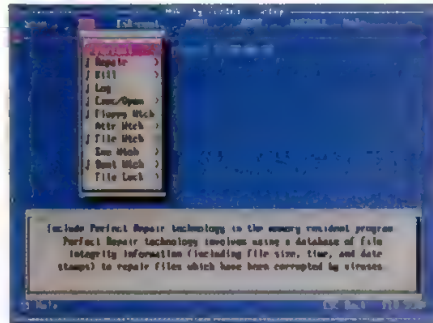
NOVI

BY JOHN R. QUAIN

Symantec's \$129 NOVI program is unique among the packages that are reviewed in this roundup. It's not designed to scan your system—though it will allow you to do so—and it does not create file checksum databases to detect file changes.

Apparently, Symantec takes the approach that it is better to stop an infection than to find it after it has occurred, because NOVI throws most of its weight behind a powerful terminate and stay resident (TSR) monitor. The program stops nearly every corrupting activity at-

tempted. Fully configurable, the TSR can range in size from 4K to 28K, depending on the level of protection, and can be loaded into high memory.



NOVI includes many powerful options with its scanning TSR. Among them is the "Perfect" integrity-checking option.

POWER PARTS

The TSR includes File Watch (which does a proprietary cyclic redundancy check (CRC) on the fly), EXE Watch (which locks the header of .EXE files), Boot Watch (which monitors boot and partition tables), and Attribute Watch (which prevents attribute changes). It can be configured to write-protect files, and a Halt option prevents inexperienced users from continuing an action when the program has detected a virus.

During installation, it prompts the insertion of a floppy disk, to which it saves the boot sector, COMMAND.COM, complementary metal-oxide semiconductor (CMOS), and hidden files (such as IO.SYS and IBMDOS.SYS) for backup.

NOVI proved it can be exceptionally tenacious. When it detects a boot-sector virus on power-on, it disallows continued boot-up and demands insertion of a clean floppy disk. In some cases, such as our polymorphic mutation engine test, NOVI's TSR prevented infection even though we chose not to kill the virus and continued the program.

A SHARP EYE

Selecting a Scan Close option enables a scan of all compressed files as they are opened. For example, in attempting to expand compressed files containing viruses, NOVI's TSR will warn you that a virus is present and allows you to clean the file.

This worked in all of PC Labs' test cases, with the exception of the Dark Avenger strain, which NOVI deleted, and the Mummy virus, which it did not detect. According to the company, the Mummy 1.1 strain is rare in the PC community and checking for it can create too many false alarms. The more common



FACT FILE

The Norton AntiVirus, Version 2.1

*Symantec Corp., 10201 Torre Ave.,
Cupertino, CA 95014; 800-441-7234,
408-252-3570; fax, 408-255-3344*

List price: \$129.

Requires: DOS version: 448K RAM, 800K hard disk space, DOS 3.1 or later. Microsoft Windows version: 1MB RAM, 1.4MB hard disk space, DOS 3.1 or later, Windows 3.0 or later.

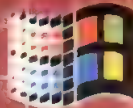
In short: A big package with a big reputation, The Norton AntiVirus handled all the viruses it encountered. Network support should attract more IS managers.



ON READER SERVICE CARD



Micro WAREHOUSE



WIN95
COMPATIBLE

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Aspen Software		
UT3243	★Cursorific Professional 3.0	29.95
Ace Software		
BS7303	★AceFile 2.0 for Windows	129.
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GR5613	★Adobe Photoshop 2.5 for Windows	559.
PR1594	★Adobe Type Manager 2.0	59.
GR5683/5	★Adobe TypeSet Value Pack	39.
Agfa		
GR5664	Desktop Styles	49.
GR6344	Discovery TrueType Pack	49.
Aldus		
GR6385/5	★Aldus PageMaker 5.0	589.
GR5034	★Aldus PhotoStyle	529.
Altiris		
BS543	★Fontographer for Windows	265.
Amaze		
BS1293	★The Far Side Daily Planner	55.
American Small Business Co.		
CA0233	Design CAD 3D 4.0	249.
Appoint		
IN2260	Thumbelina	69.95
Approach Software		
BS7374	★Approach 2.0 for Windows	249.95
Ares Software		
GR3074	★FontMonger for Windows	89.
Artisoft		
NT0110	Lantastic 2 MBPS Adapter Card	149.95
AutoDesk		
CA0173/5	Autosketch 3.0	89.
AutoMap, Inc.		
BS5224	AUTOMAP	50.
Borland International		
LN0563	Borland C++ 3.1	329.
BS7183/5	★Paradox 4.0	539.
BS7313/5	★Quattro Pro 4.0 for Windows	309.
LN0463/5	★Turbo C++ for Windows	105.
Brederbone		
BS1834	PC Globe 5.0	43.
EN0734	SimCity	29.
ED0184	Where in the USA is Carmen San Diego	32.
Brown Bag		
EX1800	Sound Blaster Pro	189.95
Caere		
IN2520	OmniPage Direct	269.
FX0314	★FaxMaster	99.
GR6234	★Image Assistant	319.

★ Capitalist Pig™ for Windows

New! Animated business simulation game challenges you to build your own business under authentic economic conditions. Experience the challenge of business, scandals, fires, terrorists, and more, as you battle for billions or bankruptcy. Make crucial decisions every minute, and enjoy the results—or suffer the consequences. Capitalist Pig is the must-have "Game of the Year" for would-be entrepreneurs of all ages. You never knew business could be so stimulating! Publisher: Pluma Software EN3663



\$35

Calera		
UT3154	★FAXGrabber 1.2	65.
Canon		
PR1500/10	Bubble Jet BJ-10ex (White/Gray)	299.
Central Point Software		
UT3033/5	★PC Tools Deluxe 8.0	129.

★ ManagePro 1.2 for Windows

PC Magazine called ManagePro an "Excellent tool for helping you become a better manager." Become more organized, achieve goals and manage people more effectively with ManagePro's integrated tools. Plan, track and delegate goals. Track progress and conduct reviews. Enter information in simple planners. ManagePro then automatically creates goal and people status boards, action lists, calendars and reports.

Publisher:
Avantus
BS7513/5

\$239

Chipsoft		
TX0554	TurboTax 1040 1992 Final	49.
Claris		
BS7294	★FileMaker Pro 2.0 for Windows	259.
Computer Associates		
GR1823	CA Cricket Graph 1.3	85.
FN0773	★Accpac Simply Accounting 2.0 (Windows)	119.
Combit Software		
BS6954	★ACT! for Windows	249.
Corel Systems		
GR5443/5	★CorelDRAW! 3.0	389.95
Dalastorm Tech.		
CM0634	★PROCOMM PLUS for Windows	99.95
DCA, Inc.		
CM0664	★Crosstalk 2.0 for Windows	89.
Deirina Technology		
FX0334	★WinFax Pro 3.0	79.
Digital Vision		
EX1610	Computer Eyes Color/RT	469.
Disks (boxes of 10)		
	BASF, Sony, Maxell, KAO and bulk Fuji	Call
Fifth Generation		
UT0724	Direct Access 5.1	65.
UT2184	Fastback Plus 3.1	125.
Fractal Design Corp.		
GR5344	★Pariter	259.95
Generic Software		
CA0074	Generic CADD 6.0	285.
Genesis Integrated Systems		
CD0840	GenStar 300i Int'l MPC CD-ROM Kit	259.
GFA Technology		
CA0254	★GFA CAD for Windows	99.
Gold Disk		
GR5763/5	★ScreenCraze 2.0 for Windows	25.
GR6194	★Video Director for Windows	119.
Hayes		
MM2210	OPTIMA 96+ FAX96	379.
MM2190	OPTIMA 144+ FAX144	479.
MM2540	Accura 2400 External	99.
Hewlett Packard		
UT2894	★Dashboard for Windows	45.
IBM		
BS2335/5	★OS/2 2.0 Upgrade DOS/Windows	96.
Jaset Systems		
UT1614	HJLink 2.1	119.
Intuit		
FN0164	Quicken 5.0	43.

FN0564	★Quicken 2.0 for Windows	49.
Imaging		
DR2080	Bernoulli 90MB Cartridge One Pack	145.95
DR2244	Bernoulli PC Powered	499.95
DR2400	Imaging Tape 250 insider	239.95
Kensington		
AC0140	Masterpiece Plus	95.
Leading Edge		
CP0250	Color Notebook 60MB	2499.
Logitech		
M1070	ScanMan 256	269.95
Lotus		
BS5793/5	★Lotus 1-2-3 4	333.95
BS5253/5	★Lotus 1-2-3 for Windows	309.95
BS7014	★Lotus Ami Pro 3.0	249.
BS6363/5	★Smart Pics for Windows	69.95
Media Vision		
IN2550	ProAudio Spectrum 16	205.95
Memory		
MY0013	SIPPS SIMMS DRAM	668.
MY0005	SIMM 1MB 100ns	75.
MY0004	SIMM 1MB 70ns	85.
	SIMM 1MB 80ns	65.
Microcom		
CM0574	★Carbon Copy for Windows	135.
Micrograph		
GR2833/5	★Windows Draw!	99.
Microsoft		
BS7553/5	★Access	89.
IN2150	Ballpoint Mouse	119.
LN0543/5	★C/C++ Compiler	319.
BS3253/5	★Excel 4.0 for Windows	299.95
BS7743/5	★FoxPro 2.5 for Windows	299.95
NO890/80	Mouse (bus/ser)	85.95
BS7253/5	★Office 3.0 for Windows	485.95
LN0633/5	Visual Basic 2.0 for Windows	99.
WP0373/5	★Word 2.0 for Windows	299.95
BS5324	★Works for Windows	129.95
MicroSolutions		
DR1240	Backpack 1.4	210.
MicroTouch Systems		
IN0810	The UnMouse	165.

Close-Up Dual Pack



Publisher:
Norton-Lambert
CM0503/5

\$119

MicroWarehouse		
BN0960	386/SX 33 MHz w/Color Monitor	999.
BN0970	486/SX 25 MHz w/Color Monitor	1299.
Monitors		
M10500	Magnavox 17" Autoscan	849.
MT0280	PanaSync C1381 14" VGA Color	369.
Panasonic		
PR2200	KX-P1124i Printer	299.95
Peachtree Software		
FN0654	Peachtree Basic Accounting 6.0	75.
Persona Technologies		
EX2060	PC Speakers	179.95

★ Typecase

Typecase is a collection of over 130 TrueType fonts that install seamlessly into Windows 3.1. Text, decorative and symbol fonts make this collection a solid foundation for any type library.

Typecase also includes a font management utility designed to archive inactive TrueType fonts. Typecase II adds over 100 more text, decorative and international symbol fonts to the Typecase library. Publisher: SWITE
Typecase II GR5853/5
\$39. Typecase GR5433/5

\$39

Polaris		
BS2894	★PackRat 4.1	25.
Practical Peripherals		
MM2100	Practical Mod. 14400FXSA V 32BIS Ext S&R	41.
Prohance		
IN2490	PowerMouse/100	9.
Quadrangle Software Corp.		
BS7433	★A Place for my Stuff	7.
Qualitas		
UT0684	386MAX 6	6.
Quarterdeck Office Systems		
EX1103/5	QEMM 386 6.0	4.
BS1043/5	Desqview 386 2.4 with ManVest	12.
Reference Software		
VP0514	★Grammatik 5 for Windows	595.
Rupp Corp.		
UT0644	★FastLynx	4.
Software Marketing		
ED0734	Autoworks	4.
Softkey Software		
GR5494	Key CAD Complete	415.
Software Publishing		
GR2303/5	★Harvard Graphics 3.0	415.
GR5063/5	★Harvard Graphics for Windows	415.
Stac Electronics		
UT1094	★Stacker 3.0	4.
SuperMatch		
GR0454	★VideoSpigot for Windows	4.
Symantec		
UT1833/5	★Norton Desktop for Windows	115.
Targus		
AC0670	Universal Notebook Case	4.
Teac		
DR0910	Teac 3.5 1.44 FD	1.
Teleware		
FN0413	★M Y O B for Windows	1.
The Complete PC		
FX0060	The Complete Communicator 3.0	2.
The Software Toolworks		
ED0913/5	★World Atlas 3.2 for Windows	2.
Touchstone		
UT1144	CheckIt PLUS	4.
Traveling Software		
UT2174	★LapLink Pro 4.0	4.
WordPerfect Corp.		
XP1163/5	★WordPerfect 5.2 for Windows	289.
XTree Company		
UT2783/5	★XTree for Windows	69.
Zoom Telephonics		
MM0910	Fax/Modem FX 9624 S/R Ext	99.
MM2140	VFX V 32 BIS Ext 14400 S/R Fax	269.

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Presentation Task Force CGM Clip Art 4.0

Now you can own the clip art PC Magazine recently called... the best CGM clip art package for overall quality and usability. Presentation Task Force is the only clip art product to feature over 3,500 high-quality, color illustrations in one value-packed, comprehensive volume! Use PTF clip art to enhance presentations, newsletters, and spreadsheets created with over 60 leading I/Os and Windows applications including CorelDRAW! Designer, Harvard Graphics, Microsoft Publisher, PageMaker, Persuasion, PowerPoint, Quattro Pro, Ventura Publisher, Word for Windows, WordPerfect, and many more. PTF 4.0 contains people, animal, business symbols, nature, illustrations, holidays, sports, military, and environment related images. Publisher: New Vision Technologies, Inc. GR3174

\$134.95

SOFTWARE
Antivirus Software

Mummy 2.2 strain should be intercepted by NOVI, according to the company.

FIXIT

NOVI offers a Perfect Repair option that returns a damaged file's header to its original state. Like many of the other tested packages, NOVI was unable to repair files infected by the mutation engine, offering only to kill the file, mak-

SUITABILITY TO TASK				
NOVI				
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	○
Removal	●	●	●	○
Prevention	●	●	●	●

ing the file unrecoverable in the process. It also could not remove the Dark Avenger virus, killing all outbreaks instead.

NOVI's interface isn't the most elegant on the market, but when its pull-down menu commands are highlighted, a prompt offers a description of the command so that you don't lose your way. The program also comes with a program information file (PIF) and an icon for Windows users.

NOVI's vigorous TSR antivirus monitor makes this package an outstanding choice for users who want to take a proactive approach. The original development company, Certus International, was purchased by Norton AntiVirus owner Symantec, so expect to see the integration of the two products soon.

► **FACT FILE**

NOVI, Version 1.15

Symantec Corp., 10201 Torre Ave.,
Cupertino, CA 95014; 800-441-7234,
408-252-3570; fax, 408-255-3344

List price: \$129

Requires: 256K RAM, 1MB hard disk space, DOS 3.1 or later

In short: NOVI was recently bought by Symantec Corp and was intended as a virus prevention program rather than a simple scanner. It does not create file checksum databases to detect file changes, but its powerful TSR can prevent major virus outbreaks. The TSR can range in size from 4K to 28K

404 ON READER SERVICE CARD

Trend Micro Devices Inc.

PC Rx

BY STEVEN C. M. CHEN

Trend Micro Devices' PC Rx, Version 2.5, offers strong virus detection and average virus prevention. Integrity-checking features are not available, and they aren't expected in the upcoming Release 3.0. But for only \$69, you get DOS, Windows, and Macintosh versions. In a novel marketing approach, Trend Micro Devices will customize the software in accordance with user requests.

The straightforward installation routine automatically creates a rescue disk that is created with a copy of the partition table and boot-sector information. In addition, it can automatically update the AUTOEXEC.BAT to include the TSR-monitoring program, PCRXT, which takes up 13K of RAM.

PCRXT works differently from most antivirus TSRs. It doesn't scan stored files for virus signatures or prevent infected files from loading. Rather, it uses a built-in database to spot viruses. This database includes rules describing how normal or uninfected executable files should act. The advantage is that it doesn't depend on the latest virus-signature library to stop new viruses. The disadvantage is that PCRXT can't act until the infected file is loaded into memory.

If the TSR detects the virus, a warning box appears indicating which files carry a virus or have been subject to attack. You must reboot to regain control of

the system so you can scan and clean the infected file. If it misses the virus, as happened a couple of times during our testing, the system hangs. In the first scenario, you would use the information provided in the pop-up box and then scan the file to identify and remove the virus.



► **FACT FILE**

PC Rx, Version 2.5

Trend Micro Devices Inc., 2421 W. 205th St.,
#D-100, Torrance, CA 90501; 800-228-5651,
310-782-8190; fax, 310-328-5982;
BBS, 310-320-2523

List price: \$69

Requires: 10K RAM, 426K hard disk space, DOS 2.0 or later

In short: PC Rx is a good deal. Prevention is one area that may be a concern, however. The rule-based TSR will let virus-infected files execute before it takes control; you will have to reboot the system and run the scanner to identify the virus.

405 ON READER SERVICE CARD

Under Windows, the TSR only beeps. In the upcoming Version 3.0, a warning also will pop up in Windows.

In PC Labs' tests, PCRXT let 3 of our 13 virus-infected test files load undetected.

CHECK ME OUT, DOC

When the standalone scanner PCRX detects a virus, you can either clean, delete, or rename the file, or you can continue scanning. A complete report is saved to the disk. On our tests, PCRX had no problem repairing the damage done to the hard disk by the boot-sector virus. A separate utility, however, must be used to remove infections from bootable floppy disks. This is achieved by making the disk unbootable. PCRX detected every infected file and maintained an average removal rating. Both the DOS and Windows versions use the same virus-signature library.

PC Rx 2.5's documentation is remarkably well organized and easy to read. Technical support is available via telephone, bulletin board systems (BBSs), or CompuServe.

PC Rx is an antivirus package that offers good virus-fighting performance at a low price, and all future signature-library updates are free and can be obtained via BBSs. But in light of the coming release of PC Rx, Version 3.0, which will include

SUITABILITY TO TASK				
PC Rx				
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	○	○
Prevention	●	●	○	○

SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Antivirus Software



Products listed in alphabetical order

■ = YES □ = NO

	AntiVirusPLUS	Central Point Anti-Virus for DOS and Windows	Data Physician PLUS!	Detect Plus	Dr. Solomon's Anti-Virus Toolkit	F-Prot Professional
List price (standalone version)	\$99.95	\$129.00	\$49.00	\$129.00	\$150.00	\$49.00
Operational Features						
Password protection	□	■	□	□	■	□
Automatic installation routine	■	■	■	■	■	■
Scans memory during installation	■	■	■	■	■	■
Modifies CONFIG.SYS during installation	□	■	□	□	□	□
Modifies AUTOEXEC.BAT during installation	■	■	■	■	■	■
Creates "emergency disk"	■	■	□	■	■	□
Stores copy of boot sector	■	■	■	■	■	□
Stores copy of CMOS	■	■	■	■	□	□
Detection						
Signature scanning:						
Scans entire file	■	■	■	□	■	■
Scans portion of file	■	■	□	■	■	■
Integrity checking	■	■	■	■	■	■
Checksum	■	■	■	■	■	■
Cyclical redundancy check (CRC)	□	■	□	■	■	■
Integrity database	■	■	■	■	■	■
Encrypted	■	■	□	■	■	■
Backup stored on-disk	■	□	■	□	■	□
Checks by file	■	■	□	■	■	■
Checks by directory	■	■	■	■	■	■
Checks by logical drive	■	■	■	■	■	■
Scans master boot record and partition table	■	■	■	■	■	■
Can scan both executable and nonexecutable files	■	■	■	■	■	■
Scans compressed files (such as .LHA or .ZIP)	□	□	□	□	□	□
Scans user-definable file groups	■	■	□	□	■	■
Memory scanning:						
Conventional (0-640K)	■	■	■	■	■	■
Upper memory (640K-1,024K)	■	■	■	■	□	■
High memory (1,024K-1,088K)	□	■	□	■	□	■
Extended memory	□	□	□	■	□	□
Expanded memory	□	□	□	■	□	□
Scans network drives	■	■	■	■	■	■
Allows scanning from distribution disk	■	■	■	■	■	■
Reports scan results on-screen	■	■	■	■	■	■
Prints scan results to disk	■	■	■	■	■	■
Automatically scans at scheduled time	□	■	■	■	□	□

N/A—Not applicable. The product does not have this feature.

SOFTWARE

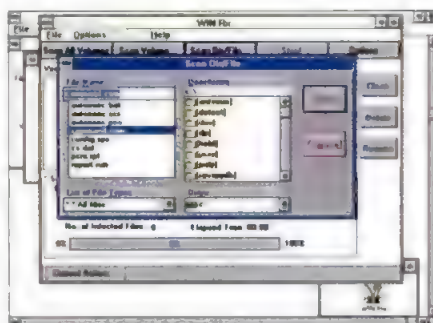
Antivirus Software

CONTINUES

	IBM AntiVirus	InocuLAN/PC
	\$29.95	\$49.00

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In WIN Rx, the Windows product included with PC Rx, you can select the files that you need to scan individually, by directory, or by drive.

an improved DOS interface, it's probably best to wait on this one.

McAfee Associates

Pro-Scan

BY GREG PASTRICK

McAfee Associates' effort to put a friendly interface on its popular collection of virus-fighting utilities with its \$89.95 Pro-Scan is a work in progress. While Pro-Scan successfully integrates all of the the basic operations of the company's popular ViruScan, Clean-up, and Vshield programs (distributed on-line for nominal registration fees), some functions of the interface are clumsy at best and inconsistent at worst.

FIRST THINGS FIRST

To use Pro-Scan, you must first install it to a hard disk, since the program files are compressed on-disk. The installation takes little time. The only addition that you will need to make to the AUTOEXEC.BAT is a line to execute the TSR monitor, PROSHLD. The TSR monitor performs basic CRC (cyclic redundancy check) analy-

sis on validated files.

Virus detection with Pro-Scan may be handled either from the DOS command line or the program's interface, but infected files can be cleaned only from within the Pro-Scan shell. All scan parameters are entered from the Pro-Scan interface by selecting desired actions from the Scan Options box, which includes parameters for the program's validation and recovery features.

If you're familiar with the McAfee Scan and Clean utilities distributed on-line, you'll have no problems here. The only difference is that all actions are logged to screen, once the files, directories, or drives to be scanned have been defined on the path-to-scan field.

EASY DOES IT

Unlike many other antivirus programs, Pro-Scan's virus detection and removal is unobtrusive—if it can remove or delete the infected file, it does so without noise or popping screens. The version we tested correctly identified and cleaned many of our test signature and polymorphic viruses, but failed to accurately remove the rare Mummy 1.2 virus.

The TSR, PROSHLD, looks for changes to the checksum of a file and notifies you when a virus has modified—but only when you attempt to execute it. Unfortunately, the program does not prevent the virus from infecting the file, so you have to hope that the virus has not done significant damage. You must know to reboot from a clean floppy disk and rescan the system to remove the virus. (The advantage of this type of TSR is that it detects modifications even by unknown viruses.) Alternately, you can drop PROSHLD and substitute Vshield, avail-

able form McAfee on-line. It offers real signature scanning, offset by increased RAM usage (37.7K), and \$25.10 in registration fees.

DOWNSIDE

Pro-Scan's reporting features are problem ridden. The program was



In Pro-Scan 3.0, all antivirus activity is logged to the default report screen in an endless stream, unless the windows are frequently closed.

SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO



	AntiVirusPLUS	Central Point Anti-Virus for DOS and Windows	Data Physician PLUS!	Detect Plus	Dr. Solomon's Anti-Virus Toolkit	F-Prot Professional	
Removal							
Removes virus by cleaning file	■	■	■	■	■	■	
Removes virus by deleting file	■	■	■	■	■	■	
Restores CMOS	■	■	■	■	■	■	
Restores master boot record	■	■	■	■	■	■	
Restores partition table	■	■	■	■	■	■	
Restores file allocation table (FAT)	□	□	□	□	□	□	
Prevention							
Resident virus monitor	■	■	■	■	■	■	
Available as a device driver	□	■	■	□	■	□	
Available as a TSR	■	■	■	■	■	■	
Updates checksum/CRC database automatically	□	■	□	□	□	■	
Monitors DOS interrupts	■	■	■	■	□	□	
Monitors memory	■	■	■	■	■	■	
Conventional (0-640K)	■	■	■	■	■	■	
Upper memory (640K-1,024K)	■	■	■	■	■	■	
High memory (1,024K-1,088K)	□	■	□	■	■	■	
Extended memory	□	□	□	■	■	□	
Expanded memory	□	□	□	■	■	□	
Protects against Trojan horses	□	■	■	■	■	■	
Protects against time/logic bombs	■	■	■	■	■	■	
Monitors files at execution	■	■	■	■	■	■	
Monitors files when copied	■	■	■	■	■	■	
Immunizes files	□	■	□	□	□	■	
Write-protects files	□	■	□	□	□	□	
Support							
Signature library updates available	■	■	■	■	■	■	
Method of updating	BBS or disk	BBS or disk	BBS or disk	BBS or disk	Disk	BBS or disk	
Frequency*							
BBS	Monthly	Monthly	Quarterly	Quarterly	N/A	Monthly	
Disk	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly/monthly	Quarterly	
Annual price:							
BBS	\$75	Free	\$15*	\$29	N/A	Free	
Disk	\$75	\$79	\$30*	\$29	\$65/\$195 (per year)	\$79.95	
Network-specific version available	□	■	□	□	□	□	
Price	N/A	\$1,199 (5 users)	N/A	N/A	N/A	N/A	
Site license available	■	■	■	■	■	■	
Toll-free support	□	■	□	□	□	■	
BBS support	■	■	■	■	■	■	

N/A—Not applicable. The product does not have this feature.

* The first year is free.

SOFTWARE
Antivirus Software

CONTINUES

	IBM AntiVirus	InocuLAN/PC
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	■	■
	■	■
	□	□
	■	■
	■	■
	□	□

	■	■
	□	□
	■	■
	■	N/A
	■	■
	■	■
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	□	■
	□	□
	□	□

	■	■
	BBS or disk	BBS
	Quarterly	As needed
	Quarterly	N/A
	Free	Free
	\$59.95	N/A
	□	■
	N/A	Free
	■	■
	□	■
	■	■

SUITABILITY TO TASK

Pro-Scan

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	○	○
Prevention	●	●	○	○

inconsistent in its ability to write reports to filenames other than the default name. Worse yet, you can't display reports except the default. McAfee Associates says this bug is being fixed. Even so, unless you frequently close the default screen, the program reports to screen in one long, unending stream.

Another frustration is that the program's multiple on-screen windowing capabilities don't give you multiple scan windows. You get one scan window; all others are devoted to screens for the exceptions file list (e.g., "ignore WIN.INI"), user-defined search strings, and program configuration. Running the Pro-Scan interface from a floppy disk presents a problem, too. You have to leave the write-protect tab open to get any reporting to screen, inviting infection of the software.

The product's validation and recovery features are its greatest strengths. All the familiar add and check validation, and certify features are available from the Scan Options menu, as are the add and check recovery features. You can easily update or remove the information gathered by these utilities, too.

► **FACT FILE**

Pro-Scan, Version 3.0

McAfee Associates, 3350 Scott Blvd., Bldg. 14, Santa Clara, CA 95054; 408-988-3832; fax, 408-970-9727; BBS, 408-988-4004

List price: \$89.95.

Requires: 256K RAM, 370K hard disk space, DOS 2.0 or later.

In short: The Pro-Scan interface automates and integrates most of the operations of the well-known McAfee antivirus utilities and its command line switches. The interface is not quite ready for prime time, however, and Pro-Scan has other flaws that need to be worked out.

 ON READER SERVICE CARD

If you are a fan of McAfee Associates' antivirus products and you are comfortable running the software from batch files or from the command line, the choice is simple: Stick with downloadable utilities. If you are attracted by the product's strong reputation but want the comfort of a menu interface, go for Pro-Scan. We would recommend paying the extra money in order to get the high-level Vshield monitor.

Fifth Generation Systems Inc.

Untouchable

BY JOHN R. QUAIN

Despite marketing that touts this \$99 Untouchable antivirus package as impregnable, we found this generally solid product, requiring about 1.8MB of disk space (a rather hefty amount for a utility package), to be somewhat more human in nature, especially when it came to file repair. Obviously, no single antivirus program will immunize your PC completely, and while Untouchable was able to detect every virus it confronted, we found its terminate and stay resident (TSR) virus-prevention monitor weak in some areas.

There are three basic components to Fifth Generation's approach. The first is a TSR monitor, which takes up from 1K to 5K of memory and looks for known viruses and virus-like activity. The second is a scanner that scans disks using a virus signature database. The third is a file-modification detector that compares



Untouchable's scanner can check compressed files (such as .LHA and .ZIP) for viruses before they infect the system.

SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO



	The Norton AntiVirus	NOVI	Panda Pro	PC Rx	Pro-Scan	Untouchable	
List price (standalone version)	\$129.00	\$129.00	\$79.95	\$69.00	\$89.95	\$99.00	
Operational Features							
Password protection	■	■	□	□	■	■	
Automatic installation routine	■	■	■	■	■	■	
Scans memory during installation	■	■	■	■	■	■	
Modifies CONFIG.SYS during installation	■	□	□	□	□	■	
Modifies AUTOEXEC.BAT during installation	■	■	□	■	□	■	
Creates "emergency disk"	■	■	□	■	□	■	
Stores copy of boot sector	■	■	■	■	□	■	
Stores copy of CMOS	■	■	□	□	□	□	
Detection							
Signature scanning:							
Scans entire file	□	□	□	■	■	■	
Scans portion of file	■	■	■	□	■	□	
Integrity checking	■	■	■	□	■	■	
Checksum	■	■	■	N/A	■	■	
Cyclical redundancy check (CRC)	□	□	□	N/A	■	■	
Integrity database	■	□	■	□	■	■	
Encrypted	■	N/A	□	N/A	■	■	
Backup stored on-disk	□	N/A	□	N/A	□	■	
Checks by file	■	■	■	■	■	■	
Checks by directory	■	■	■	■	■	■	
Checks by logical drive	■	■	■	■	■	■	
Scans master boot record and partition table	■	■	■	■	■	■	
Can scan both executable and nonexecutable files	■	■	■	■	■	■	
Scans compressed files (such as .LHA or .ZIP)	□	□	□	□	■	■	
Scans user-definable file groups	■	■	■	■	■	■	
Memory scanning:							
Conventional (0-640K)	■	■	■	■	■	■	
Upper memory (640K-1,024K)	■	■	■	■	■	□	
High memory (1,024K-1,088K)	□	□	■	■	■	□	
Extended memory	□	□	■	□	□	□	
Expanded memory	□	□	■	□	□	□	
Scans network drives	■	■	■	■	■	■	
Allows scanning from distribution disk	■	■	■	■	□	■	
Reports scan results on-screen	■	■	□	■	■	■	
Prints scan results to disk	■	■	■	■	■	■	
Automatically scans at scheduled time	■ (Windows version only)	□	□	□	□	■	

N/A—Not applicable. The product does not have this feature.

Antivirus Software

CONTINUES

	Vaccine	Victor Charlie
	\$129.00	\$50.00 (shareware registration)
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	☐	☐

two databases of encrypted file signatures. Every time you reboot, Untouchable detects new files and writes new integrity-check signatures. Wearing a better-than-average DOS graphical interface, Untouchable includes a scheduler for running periodic scans and allows password protection.

TOUGH AND GO

The program's automatic installation will scan, create a safe floppy disk (with boot sector, partition table, and complementary metal-oxide semiconductor (CMOS) information), and create on-line and off-line databases. Two annoyances we found were that the program does not automatically make its safe floppy disk bootable (the user must do it manually), and it requires the package's serial number on each installation.

Now that compression algorithms have become more popular, one attractive feature of Untouchable is its ability to scan compressed files, including .ZIP, .LHA, .ARJ, LZEXE, and PKLITE for-

SUITABILITY TO TASK**Untouchable**

	POOR	FAIR	GOOD	EXCELLENT
Detection	☒	☒	☒	☒
Removal	☒	☒	☐	☐
Prevention	☒	☒	☒	☒

mats. Unfortunately, the program's TSR does not perform such a scan and does not prevent you from expanding infected files onto a hard disk from a floppy disk. Furthermore, if the file has been encrypted with a password, the TSR cannot detect the virus within—though it will warn you if this is the case.

COURSE OF ACTION

When a virus is encountered, Untouchable's options include removing the virus, disinfecting all infected files, erasing the file, continuing, or aborting the scan.

Of the four executable files that make up Untouchable, three automatically scan memory before loading and allow you to remove the infection before running any of them. This makes it difficult to infect the program. When we did infect other files on a hard disk, the program caught every strain, though it could not

FACT FILE**Untouchable, Version 1.13**

*Fifth Generation Systems Inc.,
10049 N. Reiger Rd., Baton Rouge, LA
70809-4562; 800-873-4384, 504-291-7221;
fax, 504-295-3268*

List price: \$99.

Requires: 512K RAM, 1.8MB hard disk space, DOS 3.0 or later.

In short: Untouchable, Version 1.13, provides all the standard antivirus defenses. The program allows users to scan for viruses at scheduled intervals and scans compressed files. Its only weakness is its limited repair capabilities.



ON READER SERVICE CARD

repair files damaged by the Yankee Doodle, Mummy, or polymorphic viruses.

Untouchable's file-integrity database also worked well, detecting and noting any changes made to files. The program's TSRs cannot, however, prevent boot-sector modifications, though they can be solved using the rescue floppy disk made during installation.

Although Untouchable is not untouchable, it is a welcome addition to the field. Net administrators should take note that the company has a network version and also plans to release a NetWare Loadable Module (NLM) version of Untouchable for Novell, starting at \$995. It was not available for testing.

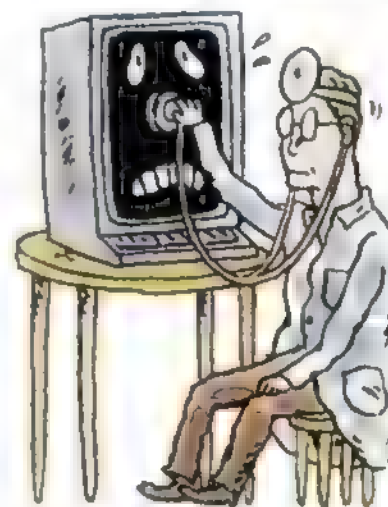
The Davidsohn Group

Vaccine

BY GREG PASTRICK

Vaccine, Version 5.0, which costs \$129, is most notable for its aggressive restrictions of executable-program operations. And its approach to virus removal is equally aggressive in its preference for file deletion over virus removal.

This package has all the marks of a solid piece of anti-virus software, including scan-



SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO



	The Norton AntiVirus	NOVI	Panda Pro	PC Rx	Pro-Scan	Untouchable	
Removal							
Removes virus by cleaning file	■	■	□	■	■	■	
Removes virus by deleting file	■	■	■	■	■	■	
Restores CMOS	■	■	□	□	□	□	
Restores master boot record	■	■	■	■	■	■	
Restores partition table	■	■	■	■	■	■	
Restores file allocation table (FAT)	□	□	□	□	□	□	
Prevention							
Resident virus monitor	■	■	■	■	■	■	
Available as a device driver	■	□	□	□	□	□	
Available as a TSR	■	■	■	■	■	■	
Updates checksum/CRC database automatically	■	■	■	N/A	□	■	
Monitors DOS interrupts	■	■	■	■	□	■	
Monitors memory	■	■	□	■	■	■	
Conventional (0-640K)	■	■	N/A	■	■	■	
Upper memory (640K-1,024K)	■	■	N/A	■	■	□	
High memory (1,024K-1,088K)	□	□	N/A	■	■	□	
Extended memory	□	□	N/A	□	□	□	
Expanded memory	□	□	N/A	□	□	□	
Protects against Trojan horses	■	■	■	■	□	■	
Protects against time/logic bombs	■	■	■	■	□	■	
Monitors files at execution	■	■	■	■	■	■	
Monitors files when copied	■	■	■	■	■	□	
Immunizes files	□	□	□	■	□	□	
Write-protects files	□	■	□	□	□	□	
Support							
Signature library updates available	■	■	■	■	■	■	
Method of updating	BBS or disk	BBS	Disk	BBS or disk	Disk	BBS or disk	
Frequency:							
BBS	Monthly	Quarterly	N/A	Monthly	N/A	Monthly	
Disk	Quarterly	N/A	Quarterly/monthly	Semiannually	Quarterly	Quarterly	
Annual price:							
BBS	Free	Free	N/A	\$19*	N/A	Free	
Disk	\$69	N/A	\$65/\$195	\$38*	\$55	\$60	
Network-specific version available	□	□	□	■	□	■	
Price	N/A	N/A	N/A	Varies	N/A	\$995	
Site license available	■	■	■	■	□	■	
Toll-free support	□	□	■	□	□	■	
BBS support	■	■	□	■	□	■	

N/A—Not applicable. The product does not have this feature.

* The first year is free.

	Vaccine	Victor Charlie
	■	□
	■	■
	■	□
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	■	■
	□	□
	■	□
	■	N/A
	■	N/A
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	■	□
	■	□
	■	□
	BBS or disk	N/A
	Monthly	N/A
	Monthly	N/A
	Free	N/A
	\$34.99*	N/A
	■	■
	Varies	Varies
	■	■
	■	□
	■	■

SUITABILITY TO TASK

Vaccine

	POOR	FAIR	GOOD	EXCELLENT
Detection	☒	☒	☒	☐
Removal	☒	☒	☐	☐
Prevention	☒	☐	☐	☐

ning for known viruses, file-image checking, and stealth virus monitoring. However, as a whole, Vaccine demands a lot of attention, decision-making, and user intervention to make it function as an effective virus fighter. What's more, since the creators advocate the deletion of infected files as a primary defense, the onus is on the user to maintain current backups or keep the original program files at hand—a noble but unrealistic scenario for most of us.

OUT OF ITS ELEMENT

Vaccine 5.0 is least effective as a floppy-disk-based virus scanner and infection remover. Full hard-disk installation of the program with its terminate-and-stay-

resident programs (TSRs) active is necessary for adequate virus detection and prevention. The program's install routine automatically creates the Vaccine subdirectory and copies all program files to it, but you need to add the TSR lines and additional command line switches to the AUTOEXEC.BAT file manually.

Once a collection of disparate utilities, Vaccine's programs are now drawn together under the Vacshell interface. All scanning options, target selection, editing of authorized program files or



Vaccine's displays are informative, but they do give a hint of the level of user intervention and decision making required by the program.



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SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

☒ = YES ☐ = NO	Virex for the PC	VirusCide Plus	VirusSafe	Virus Alert	Virus Buster	VirusCure Plus	
List price (standalone version)	\$49.95	\$69.00	\$99.00	\$39.95	\$129.00	\$99.95	
Operational Features							
Password protection	☐	☐	☒	☐	☒	☐	
Automatic installation routine	☒	☒	☒	☒	☒	☒	
Scans memory during installation	☒	☒	☒	☒	☒	☒	
Modifies CONFIG.SYS during installation	☐	☐	☒	☐	☒	☐	
Modifies AUTOEXEC.BAT during installation	☒	☒	☒	☐	☒	☒	
Creates "emergency disk"	☒	☒	☒	☐	☒	☐	
Stores copy of boot sector	☒	☒	☒	☐	☒	☒	
Stores copy of CMOS	☒	☒	☒	☐	☐	☐	
Detection							
Signature scanning:							
Scans entire file	☒	☒	☐	☒	☒	☒	
Scans portion of file	☒	☒	☒	☒	☒	☒	
Integrity checking	☒	☒	☒	☐	☒	☐	
Checksum	☒	☒	☒	N/A	☒	N/A	
Cyclical redundancy check (CRC)	☒	☐	☐	N/A	☐	N/A	
Integrity database	☒	☐	☒	☐	☒	☐	
Encrypted	☒	N/A	☒	N/A	☒	N/A	
Backup stored on-disk	☒	N/A	☐	N/A	☒	N/A	
Checks by file	☒	☒	☒	☒	☒	☒	
Checks by directory	☒	☒	☒	☒	☒	☒	
Checks by logical drive	☒	☒	☒	☒	☒	☒	
Scans master boot record and partition table	☒	☒	☒	☒	☒	☒	
Can scan both executable and nonexecutable files	☒	☒	☒	☒	☒	☒	
Scans compressed files (such as .LHA or .ZIP)	☒	☐	☐	☐	☐	☒	
Scans user-definable file groups	☒	☒	☒	☒	☒	☐	
Memory scanning:							
Conventional (0-640K)	☒	☒	☒	☒	☒	☒	
Upper memory (640K-1,024K)	☒	☒	☒	☒	☐	☒	
High memory (1,024K-1,088K)	☐	☐	☒	☒	☐	☒	
Extended memory	☐	☐	☐	☐	☐	☒	
Expanded memory	☐	☐	☐	☐	☐	☒	
Scans network drives	☒	☒	☒	☒	☒	☒	
Allows scanning from distribution disk	☒	☒	☒	☒	☒	☒	
Reports scan results on-screen	☒	☒	☒	☒	☒	☒	
Prints scan results to disk	☒	☒	☒	☒	☒	☒	
Automatically scans at scheduled time	☐	☐	☒	☐	☒	☐	

N/A—Not applicable: The product does not have this feature

CONTINUES

FACT FILE

Vaccine, Version 5.0

*The Davidsohn Group, 20 Exchange Pl.,
New York, NY 10005; 800-999-6031,
212-422-4100; fax, 212-422-1953*

List price: \$129.

Requires: 384K RAM, 1MB hard disk space, DOS 3.3 or later.

In short: If your antivirus software search is targeted toward a streamlined, fire-up-and-forget solution, Vaccine is a far too labor-intensive product to meet that criterion. Too often the user has to determine what's a virus and what's not. The program rarely lets you forget it's there.



virus definitions, and a log of program activity are launched from the drop-down menus. One exception is XRAY, which backs up the contents of the complementary metal-oxide semiconductor (CMOS) to a secure disk.

RESULTS

Running with the default values set, Vaccine had the most trouble dealing with our test FroDo and Mummy viruses. A key post-installation step is to create a file integrity (or fingerprint) database of critical files on the hard disk by initiating a boot sector and secured file search with the fingerprint-check feature enabled from the scan options menu. Without the file fingerprints, Vaccine was notably ineffective at picking up polymorphic virus activity. When the software compares its file fingerprints to the original file to detect virus activity or changes in the fingerprints, an actions box pops up identifying either the virus or some unauthorized program activity. In the case of an identified virus, actions include continuing, stopping, using Unvirus (Vaccine's feature for cleaning infected files), or deleting suspect files. With the TSRs active, unauthorized program or virus-like activity pops an alert box that offers reboot or program termination actions as defaults.

Vaccine's virus prevention relies heavily on the interaction of the anti-stealth TSR, the main Vaccine TSR, and the authorized program file (APF) list. Initially, Vaccine intercepts all program

activity and you build an APF by authorizing its actions from the Vaccine TSR alert box. Any questionable activity may be terminated, and you can edit the APF from the Vacshell interface to further define authorized actions.

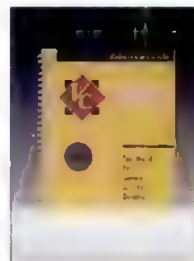
This is labor-intensive software, and too many of our test files became infected to allow us to recommend it.

Computer Security Associates

Victor Charlie

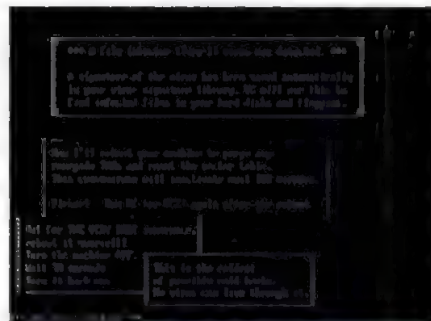
BY STEVEN C. M. CHEN

Victor Charlie, Version 5.0, is a \$50 shareware package from Computer Security Associates, the U.S. distributors for Bangkok Security Associates. In the hands of an experienced user, it can be a powerful virus-detection tool, since its checksum techniques are quite powerful. However, it can't remove viruses from infected files—deletion is the only option.



THE MISSION BEGINS

Installation is straightforward and only takes a few minutes. Just don't forget to initialize Victor Charlie every time you make changes, such as adding a new terminate and stay resident program (TSR)



In Victor Charlie, capturing a virus signature can be easy, provided you have the right bait—as we did in this instance.

or device driver, since it takes a snapshot of your RAM—up to 640K—during installation. You access Victor Charlie's features via an easy-to-use menu or the included batch files to launch different utilities.

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 □ package includes both 5¼" and 3½" disks.
 □ 3½" format available from manufacturer by request. Call us for details.
 All software is not copy-protected, unless indicated otherwise by (CP).

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

We carry only the latest versions of products. Version numbers are current at press time. Products listed here in red are Microsoft Windows Applications.

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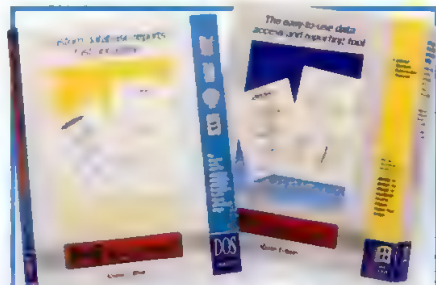


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3574	Ext. 2400 Baud V.42/9600 Baud Fax.....	115.
3386	FaxModem AFC (2400 baud 96S/48R).....	59.
4430	FaxModem AFX (2400 baud 96S/48R).....	79.
4429	FaxModem VFP V.32bis 14,400 baud (internal) 219.	
4428	FaxModem VFX V.32bis 14,400 baud (external) 259.	
7921	Pocket FaxModem.....	87.

DRIVES

Colorado Memory Systems ... 1 year		
4194	Jumbo 120 Tape Backup.....	199.
4354	Jumbo 250 Tape Backup.....	269.
1213	Trakker 120 Tape Backup (parallel).....	359.
1073	Trakker 250 Tape Backup (parallel).....	429.
Conner Peripherals ... 1 year		
2339	CP30104H 120 MB IDE HD (19 ms).....	299.
1337	CP3204 200 MB IDE HD (16 ms).....	429.

Logitech ... limited lifetime/MECA
3295 Mouseman (combo)—3 button ergonomic mouse..... \$69.
3885 TaxCut 1992 for Windows—Guaranteed accurate tax preparation.... 37.
10573 Mouseman with TaxCut Windows 99.

IOMEGA ... 1 year		
6499	Transportable 90 PRO.....	659.
10452	Transportable Multidisk 150.....	849.
6343	PC Powered 90 (incl. PC2B & cartridge).....	499.
6344	PC Powered 90 PRO (incl. PC2B, cartridge & Central Point Software).....	599.
10537	PC Powered 150.....	799.
10457	Dual Multidisk 150.....	1699.
2500	PC2B-2 Controller.....	149.
2530	90 MB Cartridge..... 149... 2467 Tripak.....	439.
8480	Tape250 Insider Tape Backup.....	239.
8481	Tape250 Inside Half-Height Tape Backup.....	259.
8482	Tape250 PC Powered Tape Backup.....	359.
10103	21 MB Floptical Drive (internal).....	459.
10104	21 MB Floptical Drive (PC Powered).....	499.
NEC ... 2 years		
6582	CDR74 Portable CD-ROM Drive.....	629.
6581	CDR84 Internal CD-ROM (reqs. interface).....	569.
Pacific Rim ... 1 year		
1304	1.2 MB External (for any parallel port).....	239.
2761	1.44EX MB Ext. (for any parallel port).....	239.
Peripheral Land, Inc. ... 1 year		
8735	Infinity Floptical Drive.....	399.
8736	Infinity 88 MB Removable (Syquest).....	699.
Quantum ... 2 years		
8287	Plus Hardcard II XL 105 MB (9 ms).....	325.
4735	Hardcard E7 127 MB IDE (17 ms).....	329.
4714	Hardcard E7 240 MB IDE (16 ms).....	549.
TEAC ... 1 year		
6951	1.2 MB Drive for AT.....	65.
4670	1.44 MB Drive for PC/XT (3 1/2").....	59.
4326	1.44 MB Drive for AT (3 1/2", with Basteach).....	75.
4414	3 1/2" 5 1/4" Dual Floppy Drive.....	145.



Compaq Computer ... 3 years

9552 Contura 3/25 with 120 MB—25 MHz
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 This high powered system includes 4 MB RAM, 64K cache, built-in trackball, 120 MB IDE hard drive, & 640 x 480 display **\$2059.**

MEMORY

6556	256k DRAMs (100 nanosecond, set of 9).....	call
5510	1 MB x 9 SIMMs (80 nanosecond).....	call
2497	4 MB x 9 SIMMs (80 nanosecond).....	call
5746	1 MB Chips (80 ns, set of 9).....	call

DISKS/MEDIA

Fuji ... lifetime		
2214	3 1/2" DS Disks (10)..... 9... 2242 (50).....	32.
2215	3 1/2" HD Disks (10)..... 15... 2241 (50).....	59.
4863	3 1/2" HD Disks (20) w/storage case.....	26.
Sony ... lifetime		
3292	5 1/4" HD Disks (Qty. 10).....	11.
3297	3 1/2" DS Disks (10)..... 9... 6148 (30).....	25.
3298	3 1/2" HD Disks (10)..... 15... 6375 (30).....	42.
8185	QD2040..... 14... 1895 QD2120.....	19.
3M ... lifetime		
3943	DC2000..... 17... 1581 DC2120.....	22.
Toshiba ... lifetime		
4858	3 1/2" 2.88 MB ED Disks (Qty. 5).....	17.
9755	3 1/2" 2.88 MB ED Disks (Qty. 10).....	29.

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SOFTWARE
Antivirus Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO	Virex for the PC	VirusCide Plus	VirusSafe	Virus Alert	Virus Buster	VirusCure Plus
Removal						
Removes virus by cleaning file	■	■	■	■	■	■
Removes virus by deleting file	■	■	■	■	■	■
Restores CMOS	■	■	■	□	□	□
Restores master boot record	■	■	■	■	■	■
Restores partition table	■	■	■	■	■	■
Restores file allocation table (FAT)	■	□	■	■	□	■
Prevention						
Resident virus monitor	■	■	■	■	■	■
Available as a device driver	□	□	□	■	■	□
Available as a TSR	■	■	■	■	■	■
Updates checksum/CRC database automatically	□	□	■	N/A	■	N/A
Monitors DOS interrupts	□	■	■	■	■	■
Monitors memory	■	■	■	■	■	■
Conventional (0-640K)	■	■	■	■	■	■
Upper memory (640K-1,024K)	■	■	■	■	□	■
High memory (1,024K-1,088K)	□	□	■	■	□	■
Extended memory	□	□	■	□	□	■
Expanded memory	□	□	■	□	□	■
Protects against Trojan horses	■	□	■	■	■	■
Protects against time/logic bombs	■	□	■	□	■	■
Monitors files at execution	■	■	■	■	■	■
Monitors files when copied	■	■	■	□	■	■
Immunizes files	■	□	■	□	■	□
Write-protects files	■	□	■	□	■	□
Support						
Signature library updates available	■	□	■	■	■	■
Method of updating	BBS or disk	N/A	BBS or disk	Disk	BBS	BBS or disk
Frequency:						
BBS	Quarterly	N/A	Monthly	N/A	Monthly	Bimonthly
Disk	Quarterly	N/A	Quarterly	Bimonthly	N/A	Bimonthly
Annual price:						
BBS	Free	N/A	Free	N/A	\$100	Free
Disk	\$50	N/A	\$19.95	\$20	N/A	\$15
Network-specific version available	□	□	■	■	■	□
Price	N/A	N/A	\$595	Included	\$290	N/A
Site license available	■	■	■	■	■	■
Toll-free support	□	□	□	■	□	□
BBS support	■	□	■	□	■	■

N/A—Not applicable: The product does not have this feature

* The first year is free

SOFTWARE

Antivirus Software

ENDS

	VirusNet	Vi-Spy Professional
	☒	☒
	☒	☒
	☐	☐
	☒	☒
	☐	☒
	☐	☒
	☒	☒
	☒	☐
	☒	☒
	N/A	☒
	☒	☒
	☒	☒
	☒	☒
	☒	☒
	☒	☐
	☐	☐
	☐	☐
	☐	☒
	☐	☒
	☒	☒
	☒	☒
	☐	☐
	☐	☐
	☒	☒
	☒	☒
	BBS or disk	Disk
	As needed	N/A
	Quarterly	Quarterly
	\$25	N/A
	\$25	\$99.95*
	☒	☐
	\$595	N/A
	☒	☒
	☐	☐
	☒	☒

VC's first line of defense, called System Monitoring, is part of the boot process. Critical system areas such as the partition table and up to 15 user-designated files can be checked during every boot-up. During PC Labs' tests, VC successfully both detected and repaired the damage done by both the Michelangelo and Stoned boot-sector viruses.

Unlike other programs, Victor Charlie offers no TSR. Instead, you set a trap by running a pair of programs called VC1 and VC2 to invite virus attacks whenever you suspect there's a virus in memory. One is a .COM file (to bait viruses that attack .COM files), the other is an .EXE (to bait viruses that attack .EXE files). If attacked, VC1 and VC2 capture the virus signature and save it to a file for later use by the scanner.

With this cyber-fishing technique, we were able to hook and land 10 of the 13 test viruses. But in the case of the Green Caterpillar virus, even with the newly acquired signature in its library, the scanner wasn't able to detect the infected file.

Victor Charlie's signature library includes some common virus signatures, but doesn't provide the names of the viruses or describe the symptoms or system errors they might create on a PC. As a result, differentiating between virus activity and some other system problem

is often difficult. This can make troubleshooting difficult. Of the 12 files infected with the signature viruses, only 9 were detected. None of the files infected with the Dedicated virus were detected.

Checksum (or bit-checking) is the final defense. In our tests, it detected all the damage done by the Dedicated virus after the previous

scanning steps failed. Checksum is also one of the slowest processes, so be prepared to wait for a few minutes—especially if you have a lot of executable files.

DETECTIVE TRAINEES, BEWARE

Every time you run a new checksum in Victor Charlie, you will get a list of files that have changed since the last time you ran checksum. Sorting things out and making the final determination of whether or not the change was caused by a virus is up to you, the detective. However, by then, it's usually too late. Ideally, you will have a virus-free backup ready, since Victor Charlie checksum will not reconstruct the file.

Victor Charlie is not designed for typical users. With its idiosyncratic technology, it's not particularly dependable, either, even for users who want to stretch themselves to the limit. Yet, in the hands of experienced, technical users ready to decide for themselves if their symptoms are virus related, VC can be a useful, if challenging, tool.

FACT FILE

Victor Charlie, Version 5.0

Computer Security Associates, 738½ Meeting St., West Columbia, SC 29169;
803-796-6591; fax, 803-796-8379;
BBS, 803-791-5421

List price: \$50 (shareware registration).

Requires: 512K RAM, 1MB hard disk space, DOS 3.0 or later.

In short: Capturing virus signatures is easy with Victor Charlie, as long as the virus is in memory and attacking when Victor Charlie is on guard. Detecting a virus-infected file with the captured signature is a different story.

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SUITABILITY TO TASK

Victor Charlie

	POOR	FAIR	GOOD	EXCELLENT
Detection	☒	☒	☐	☐
Removal	☒	☒	☐	☐
Prevention	N/A			

Datawatch Corp.

Virex for the PC

BY GREG PASTRICK

The appeal of Virex is enhanced by its latest addition: a more developed menu-driven interface and effective terminate and stay resident program (TSR). These enhancements do not sacrifice the package's straightforward approach to virus prevention. In total, Virex 2.2 maintains



SOFTWARE

Antivirus Software

the proven versatility of its original command line-driven functionality.

Over the last two years, Virex has undergone two major upgrades that have vastly improved its functionality and virus-fighting capabilities. Along with the improvements came a surprising \$34 drop to its current \$45.95 list price.

In addition to its own built-in scanner, Version 2.2 supports Datawatch's BBS-distributed VIRx scanner and comes with two virus-monitoring TSRs, a scanner (VPCScan) with checksum and file inoculation capabilities, plus support for Novell networks and Microsoft Windows.

VIRUS RX

Full installation of Virex is a three-step process: copying the main program files to hard disk, adding a line to your AUTOEXEC.BAT to implement the automatic loading of the TSR, and installing the program interface (VPCShell). The interface installation also lets you configure the software for use under Windows and set up an emergency recovery disk. You can choose to install the software without the interface and run the product from the command line. Dur-

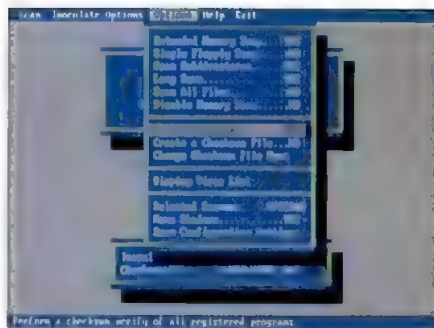
SUITABILITY TO TASK

Virex for the PC

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	○
Removal	●	●	●	○
Prevention	●	●	○	○

ing the full installation, two essential files, called the Inoculation Set, are created; CRITICAL.VRX holds the master boot record (MBR) and complementary metal-oxide semiconductor (CMOS) information, while INOC.VRX holds the initial bytes along with checksums for all executable programs on the hard disk.

Virex's scanner, VPCScan, is fast and



Virex for the PC's interface is a finely developed and efficient shell. Here, a scan to verify checksum information is being set up.

VIRx is that you can't remove viruses, only delete infected files.

SUM IT UP

Virex also includes basic file-integrity checking in its checksum database, which may be used and updated independent of the TSR's watch on file and MBR changes. However, when verifying checksums, your only options are to ignore or update recognized changes in files, with no option for restoring the changed file.

While the checksum database exists primarily as a reference for the Virex TSR to allow or remove changed files, the inoculation set is used for critical file restoration based on detected file changes. You may restore files or update the inoculation set from the command line or the Inoculation menu. The alert boxes clearly state the course of action to take when the program detects or suspects infection.

Of the two TSRs included with Virex, VirexPro provides a more powerful form of virus protection. It is more aggressive in interrupting and monitoring program activity and provides more messages and alerts about system operations. The penalty you pay is high overhead—over 40K, nearly double what the standard TSR needs. The program installation defaults to the less intrusive Virex TSR and recommends using it, especially if you're loading network drivers and Windows, as we did in our tests.

Virex for the PC is not flawless, but it does give you a solid line of antivirus

efficient. In our tests, VPCScan could not detect the presence of polymorphic virus activity while the more frequently updated VIRx could. Quarterly updates for VPCScan are free for the first six months following purchase and \$75 per year after that. The trade-off with

FACT FILE

Virex for the PC, Version 2.2
*Datawatch Corp., 3700 Lyckan Pkwy.,
 Suite B, Durham, NC 27707; 919-490-1277;
 fax, 919-419-8312*

List price: \$49.95
Requires: 512K RAM, 130K hard disk space, DOS 3.0 or later
In short: Virex for the PC, Version 2.2, is an effective piece of antivirus software, featuring strong checksumming and inoculation. The interface integrates the essential operations of the VPCScan utility while giving you the option to use the more frequently updated VIRx scanner

473 ON READER SERVICE CARD

defense without a lot of fine-tuning and configuration. What's more, the program includes many thoughtful features, such as automatic inoculation and checksum-file creation.

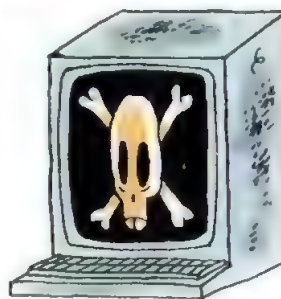
Parsons Technology Inc.

VirusCide Plus

BY GREG PASTRICK

The \$69 VirusCide Plus 3.0 gives you basic virus protection behind a no-frills interface. While the program (recently licensed by Parsons from Iris Software

Products) is able to handle common signature and boot virus threats, it lacks some of the conventional intervention features found in other anti-virus programs. In many cases, though, it's no less effective than the others in preventing the use of infected executable files.



Installation is straightforward, and the program scans memory for viruses before copying itself to disk. As part of the installation routine, VirusCide enters lines in the AUTOEXEC.BAT to launch the program's system integrity-check utility (Syscheck) and the TSR monitors on boot-up.

The program's interface consists of three drop-down menus at the top, a drive selection line, two scrolling windows for directory and file selection, a

Antivirus Software



ViruCode Plus allows a liberal range of user actions when it encounters a recognizable but uncleanable virus.

scan button, and a report button. In addition, an information window details the number of files selected, the last virus found, and the scan mode currently in use. Once a scan is completed, a report box pops up, citing bare-bones statistics (number cured, deleted, or renamed) on how detected file and boot viruses were handled.

SCAN-CIDE

ViruCode's scan options cover all the standard operations you need for disinfection, including Remove, Delete, and Remove and Save. The last saves an infected file with a nonexecutable extension.

The product uses two encrypted virus information files for detection. One is referenced exclusively by the VS2 monitor, the other by the scanner. The options menu gives you a choice of being alerted if a virus is detected or allowing the pro-

gram to handle it in the background. You can also have program activities logged directly to a file. However, this information gives you little more than a list of files scanned and what was done to them. There's no information on the nature of the infection other than whether it was a boot or a file infection. Parsons will deliver quarterly virus updates at about \$20 each. At press time, the company had not determined whether the updates would be full program replacements or new files.

ViruCode has no executable program integrity checking, file recovery, or checksumming features. Instead, it uses a system integrity-checking method that references a series of encrypted, read-only signature files that are created on installation. These signature files hold critical information about your system's boot sector, CMOS, operating system, and partition table. The signature files

are used in monitoring changes, and restoring critical areas and system information on your hard disk to its original state. So although you can create a recovery disk and restore master boot record-type information, there's no file reconstruction available for changed program files that are modified by unknown viruses. What's more, the program has no global inoculation features.

SUITABILITY TO TASK

ViruCode Plus

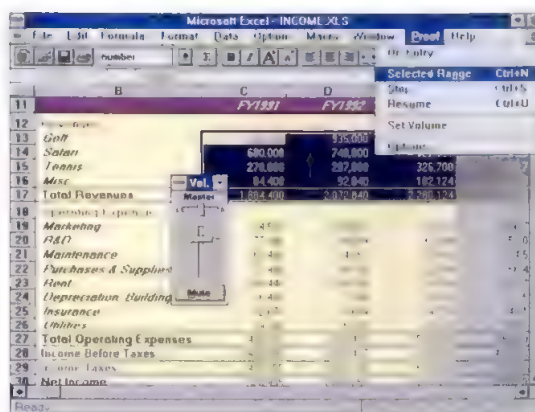
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	○	○
Prevention	●	●	○	○

KEEPING AN EYE ON IT

ViruCode comes with three monitors (VS1, VS2, and VS3) that provide alternate levels of memory-resident

protection. By default, the program uses both the VS1 and the VS2 monitors. VS1 guards against changes in the boot sector and the partition table, while VS2 references a list of specific viruses to look for in memory. If ViruCode encounters infected files that it cannot cure, as the program did with our test Mummy and mu-

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FACT FILE

ViruCode Plus, Version 3.0

Parsons Technology Inc., One Parsons Dr.,
P.O. Box 100, Hiawatha, IA 52233-0100;
800-223-6925, 319-395-9626;
fax, 319-393-1002

List price: \$69.

Requires: 640K RAM, 1MB hard disk space, DOS 3.1 or later.

In short: ViruCode Plus 3.0 has most of the basic features required of antivirus products. It secures and restores critical areas of your hard disk, but it can't reconstruct damaged executable program files beyond its disinfection capabilities.

ON READER SERVICE CARD

SOFTWARE

Antivirus Software

tating engine viruses, your option is to delete or rename the files.

Based on our tests, the program managed to provide an adequate level of virus protection. ViruCide is, however, still lagging behind other antivirus packages in some critical areas. It lacks the more sophisticated checksumming, inoculation, and program file integrity-checking features that other programs have.

XTree Co.

VirusSafe

BY GREG PASTRICK

Thanks to a significant upgrade to its Program Integrity Check (PIC) and critical file recovery capabilities, the \$99 ViruSafe, Version 4.6, from XTree Co. is a



more comprehensive virus fighter than ever before. It's a fast-installing, quick-scanning anti-virus program with an active but easily mastered interface,

and a full-featured, command line-driven Unvirus utility. Also notable is the package's versatile and easily configured Timerun utility that will execute its virus protection programs at predefined times and dates.

Virusafe launches in characteristic XTree style with chirping windows that balloon on and off the screen. ViruSafe's tiled menus lay out all the program's features for quick access and incorporate all the essential command line switches for scanning, cleaning, and integrity checking outside of the shell. In addition, the interface offers a Global selection that will swiftly execute all the primary virus-checking utilities, checking memory and file integrity and performing virus detection and removal in one sweep.

VIRUMATIC

Virusafe takes a similarly automatic approach to virus

detection and removal when Unvirus is run from the interface or the command line. By default, the program will automatically remove known infections in files. If the virus can't be removed, an audio alert sounds and a recommended-action box appears. In our tests, the Mummy virus was not detected, and without the PIC feature enabled, no polymorphic virus activity was detected in any of the infected files.

The program's integrity-checking feature works independently from the ViruSafe monitor, which has its own editable, authorized program file for reference. ViruSafe's PIC feature detects file changes, and it allows restoration or generic disinfection of changed files based on the checksum information that it collects on initialization. The process of building the integrity database may be executed from either the command line

SUITABILITY TO TASK				
Virusafe				
	POOR	FAIR	GOOD	EXCELLENT
Detection	☒	☒	☒	☐
Removal	☒	☒	☒	☒
Prevention	☒	☐	☐	☐

or from the VSMENU shell.

To build the PIC, you have to tag all the files that need to be included in the checklist in each subdirectory on your drive. There is no way to globally tag files, except within each subdirectory. As a result, each subdirectory contains a PIC file called VS.VS once the procedure is complete. From this point on, you may update, recalculate, or remove individual files or whole directories as needed. The PIC routine also creates a hidden boot file, VSBOOT.VS, that resides in the root directory.

SAFE DISK

When creating a recovery disk, ViruSafe adds an automatic master boot record and CMOS reconstruction utility called BOOT-REST.COM. Critical boot sector

FACT FILE

Virusafe, Version 4.6

XTree Co., 4115 Broad St., Bldg. 1, San Luis Obispo, CA 93401-7993; 800-333-6561, 805-541-0604; fax, 805-541-4762

List price: \$99.

Requires: 384K RAM, 455K hard disk space, DOS 3.0 or later.

In short: XTree Co.'s ViruSafe, Version 4.6, is an adequate antivirus program, featuring a Program Integrity Check utility that not only traps changes in files but reconstructs damaged files as well. For registered users of XTree Co.'s products, the new ViruSafe is a great deal.



ON READER SERVICE CARD

information may also be restored from the Advanced Features menus in the VSMENU shell or the separate PC Checkup diagnostic utility.

Virusafe's TSR couples reasonable memory overhead with a full menu of options. The package also includes a VSMENU.PIF, so the TSR can alert you to potential virus threats with a beep when you're running Microsoft Windows.

XTree's antivirus software is a very capable protection system made better in the 4.6 upgrade. Registered users of other XTree products shouldn't pass up the special \$49.95 purchase offer, since comparably priced products often have less functionality than ViruSafe.

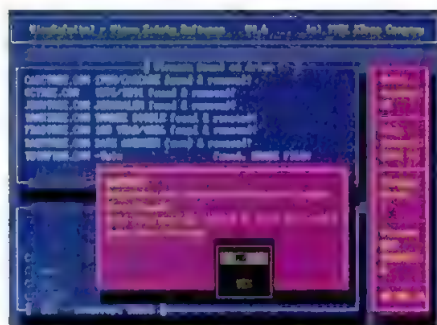
LOOK Software

Virus Alert

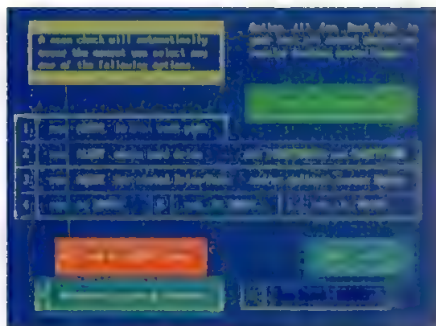
BY STEVEN C. M. CHEN

Does low cost mean bad performance? Not if you're talking about the \$39.95 Virus Alert, Version 2.05B, from LOOK Software.

Like Safetynet's VirusNet (reviewed here), Virus Alert is based on technology from Frisk Software, maker of F-Prot Professional (also reviewed in this feature). Like VirusNet and F-Prot, Virus Alert offers above-average virus detec-



Virusafe's antivirus features are enabled through a hyperactive interface that should be familiar to users of other XTree Co. products.



The multiple-layer Virus Alert menu system can be confusing at times. Here, **D** is listed as the key to hit for drive D, even though there is no drive D.

tion, removal, and prevention. Like VirusNet (but *not* like F-Prot), it lacks integrity checking.

In its attempt to create a colorful and easy-to-use interface, LOOK has succeeded in producing some of the most cluttered and illogical menu screens we've seen in a long time. The first thing you need to do is spend some time going over the menu program and the online help—especially if this is the first time you've used an antivirus program. Moreover, instead of a manual, LOOK Software has provided only a one-page, quick-start sheet with Virus Alert. You can print out the on-line help, but there's no index.

Virus Alert can be run from the command line, but you must first use the product's menu (accessed by typing "Alert" at the DOS prompt) to find out which program to use and what switches are available.

SCAN HIGHLIGHTS

The scanner performs well and is one of the few that correctly detected and identified all the viruses in PC Labs' test files, including the the polymorphic Dedicated virus. Its performance in the virus-removal tests was also nearly perfect. An on-line report is available, but it does not provide specific information on the virus itself. The absence of checksum does pose a danger, however, especially with new or next-generation viruses that the scanner cannot detect. LOOK plans to add integrity checking to a future release of Virus Alert.

Adding the handy LOCKOUT tool to AUTOEXEC.BAT will force Virus Alert to scan at boot-up. LOCKOUT also prevents you from sabotaging the scanning process by disabling the escape and the control-break keys before activating the scanner. It can also display an

optional warning message about who in your organization to call for help.

Prevention is handled by V-GUARD, a memory resident program that scans for viruses before a program is executed. On PC Labs' tests, V-GUARD stopped virus-infected files from executing—the only exception being files that were infected by the polymorphic Dedicated

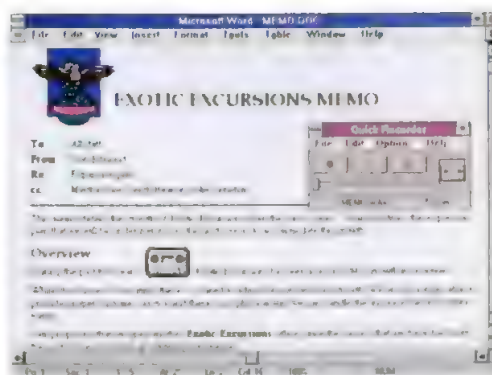
virus. V-GUARD wasn't able to detect infected files during decompression. It was also unable to check floppy disks for boot-sector viruses.

Shortly after our testing period, LOOK announced OnGuard, a brand-new utility launched from AUTOEXEC.BAT, which promises to automatically scan the root directory, memory, and boot sectors during boot-up. If it encounters a virus, the system locks and must be rebooted via floppy to delete the virus.

If you can overlook the missing man-

SUITABILITY TO TASK				
Virus Alert				
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	○

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FACT FILE

Virus Alert, Version 2.05B

LOOK Software, P.O. Box 78072 Cityview,
Nepean, Ontario, Canada K2G 5W2; 800-
267-0778, 613-837-2151; fax, 613-837-5572

List price: \$39.95

Requires: 400K RAM, 575K hard disk space, DOS 3.2 or later.

In short: LOOK Software's Virus Alert, Version 2.05B, offers solid TSRs and a scanner. Checksum is not yet one of the supported features. Basic scanning is easy to use, but some of the program's advanced features require more digging through some pretty confusing menus.

479 ON READER SERVICE CARD

SOFTWARE

Antivirus Software

ual and integrity checking and accept the interface, then the low-cost Virus Alert may be the virus cop for you.

Leprechaun Software International Ltd.

Virus Buster

BY STEVEN C. M. CHEN

The \$129 Virus Buster, Version 3.93, from Leprechaun Software International, bundles an average virus-prevention TSR with up-to-date virus scanning and integrity checking that will allow you to restore files.



The package has no central command shell. Rather, each utility comes with look-alike, stand-alone pull-down menu structures. In total, it adds up to a decent, easy-to-use antivirus software package.

THREE FRONT LINE DEFENSES

Virus Buster installs two device drivers, VBSHIELD and VBSAVER. Together, they use about 5K of RAM and should stop most viruses from infecting a system. VBSHIELD and VBSAVER are backed up by WATCHDOG, a TSR that reads the 3-byte checksum generated by the PROTECT utility. WATCHDOG analyzes the checksum and issues a warning if it detects an irregularity. Other options include the ability to write-protect boot records, disks, and partition tables.

If you suspect there's a virus in the house, try DOCTOR, Virus Buster's scanning program. On PC Magazine Labs' tests, it detected all infected files. Most signature-type viruses were successfully removed, but in two cases, the files did not operate properly after disinfection. DOCTOR recommended that files infected with the polymorphic

Dedicated virus be deleted.

None of Virus Buster's memory-resident programs were able to detect compressed, virus-infected files during decompression, but they did stop the infected files from being copied. Files infected with the Green Caterpillar, Mummy, and Dedicated viruses, however, were allowed to execute.

FULL-RECOVERY CHECKSUM

We looked at the integrity-checking program, BUSTER, and found it to be one of the few programs that can restore infected files as well as detect them. In PC Labs' tests, BUSTER was admirably able to detect changes made by the Dedicated virus and then fully restore files to their preinfected state.

Unfortunately, DOCTOR and BUSTER are not integrated; information from one program can't be directly passed to the other. For example, if BUSTER determines that the checksum on a file has changed, you have to manually run DOCTOR to find out if it is actually infected. Another weak point is that BUSTER does not check itself before running.

The installation is simple and the doc-



Virus Buster's scanner utility, DOCTOR, prompts you with the available options when it detects files infected with viruses.

umentation is extensive. But better organization would make the hefty manual (more than 300 pages long) a little easier to read. Additionally, the on-line help could use more extensive and specific information.

Overall, Virus Buster offers users above-average per-

formance on virus detection and removal, which is backed up by a top-notch checksum program that can reliably restore files.

RG Software Systems Inc.

Vi-Spy Professional

BY STEVEN C. M. CHEN

With an almost perfect performance in prevention and detection, Vi-Spy Professional (\$149.95), from RG Software Systems, is hard to beat. The latest version also includes a checksum feature, just in case either the TSR or the scanner fails to stop the virus. And in spite of the high cost and an average menu system, the product is still well worth your scrutiny.



Need to find out what's in memory? Vi-Spy lets you view the memory map and save it. Next time, if anything changes, you will get a side-by-side comparison. DOS system files, partition tables, and master boot records are backed up by the installation program and can easily be restored if they are damaged in some way by a virus attack.

FACT FILE

Virus Buster, Version 3.93

*Leprechaun Software International Ltd.,
P.O. Box 669306, Marietta, GA 30066;
800-521-8849, 404-971-8900;
fax, 404-971-8828; BBS, 404-971-8886*

List price: \$129.

Requires: 480K RAM, 700K hard disk space, DOS 2.1 or later.

In short: Virus Buster provides a decent combination of TSR, scanner, and checksum. But it comes up a bit short on the prevention side. The program lacks a single menu to control all the utilities. Instead, each utility must run separately.



ON READER SERVICE CARD

SUITABILITY TO TASK

Virus Buster

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	○	○
Prevention	●	●	○	○

SUITABILITY TO TASK

Vi-Spy Professional

	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	○
Removal	●	●	●	○
Prevention	●	●	○	○

STOP A VIRUS IN ITS TRACKS

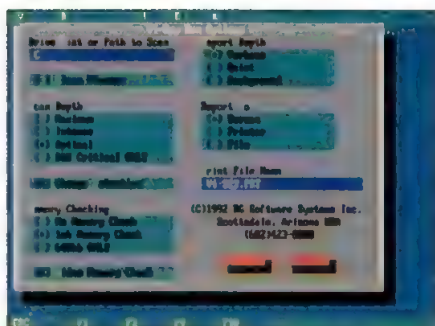
The old saying "An ounce of prevention is worth a pound of cure" rings true with Vi-Spy Professional 10.0. RVS, the software's memory-resident program, is perfect for the job. With the exception of the Mummy virus, RVS detected all signature and polymorphic viruses on PC Magazine Labs' tests. Virus-infected files can be detected during decompression, copying, or execution.

RVS can take up a lot of memory—79K. But if you load high, you can reduce conventional memory consumption down to 0.

The main program, VI-SPY, includes both scanning and checksum functions. Again, with the exception of the Mummy virus, VI-SPY as a scanner was able to detect all virus-infected files, giving us the option of either removing the viruses or deleting the files completely.

SOME OPTIONS

A shell program, VSMENU, is also available and recommended; without this shell, there are a lot of switches to memorize. You also get on-line help and documentation for the different utilities. Information on the latest updates and new



Vi-Spy Professional's menu program, VSMENU, allows you to specify different options without having to memorize command line switches.

features is also on-disk. A Windows interface is included, but it's not much more than the DOS version running under Windows.

New to this edition of Vi-Spy is the checksum, which can detect changes that are made to files—just in case either the TSR or the scanner fails. By

adding the /CDF switch to VI-SPY (or using VSMENU), a checksum database will be generated for comparison. VI-SPY will also scan new files that are not in the checksum database.

Vi-Spy is more expensive than other virus products. Even with a site license (which requires 25 or more copies of Vi-Spy), you still need to renew yearly. On the other hand, quarterly updates are automatically shipped to you for one year, and the included *Computer Virus*

Primer and Troubleshooting Guide from RG Software Systems can come in handy.

Vi-Spy offers first-rate detection and prevention, but it carries a hefty price tag. Large corporations should have no problem arranging for a site license, but individuals or smaller offices may not be able to handle the sticker shock or the yearly renewals.

IBM Corp.

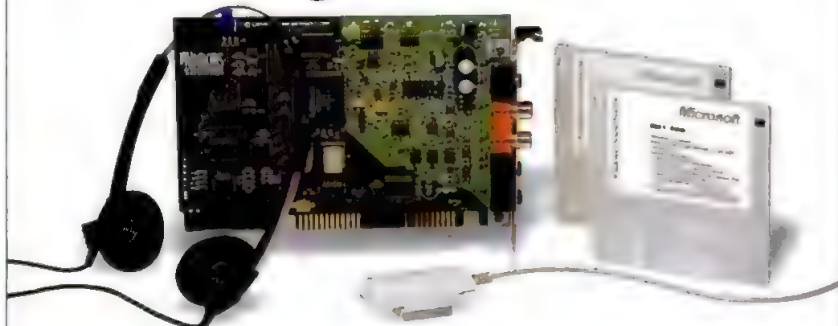
IBM AntiVirus

BY ANGELA GUNN

If, like Sherlock Holmes, you're a believer in deductive logic, you'll like the way IBM's AntiVirus software thinks. Built on a fuzzy search engine, it uses its knowledge of extant viruses to detect suspicious entities on your hard or floppy disks. This \$29.95 package is smart, cheap, and



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FACT FILE

Vi-Spy Professional, Version 10.0

RG Software Systems Inc.,
6900 E. Camelback Rd., #630, Scottsdale,
AZ 85251; 602-423-8000; fax, 602-423-8389

List price: \$149.95

Requires: 340K RAM, 1MB hard disk space, DOS 3.2 or later.

In short: This is a great package for large corporations to consider. Individuals or smaller corporations, however, may not be able to swallow the high price and yearly renewal costs. But once the cost issue is out of the way, Vi-Spy's performance will win you over.

476 ON READER SERVICE CARD

SOFTWARE

Antivirus Software

very effective.

By comparing executable code to that of known viruses, AntiVirus detects not only those viruses, but mutations as well. Meanwhile, ordinary changes to .COM and .EXE files, such as those made by legitimate product updates, will not trigger annoying false alarms. This is not a prevention package; IBM believes in detection and containment. It does those things extremely well.

The package has both a DOS and a Windows interface; an OS/2 version is also available. The foreground package can be set to run at boot-up, at specified intervals, or on command. The terminate and stay resident program (TSR), Shield, when loaded, detects a subset of the viruses detected by the foreground package.

PROTECTION FOR BUSY PEOPLE

Installation of both the foreground and background packages is painless: The TSR and scheduled checking options require changes to the AUTOEXEC.BAT file, but the package allows you to make the changes yourself. The foreground package looks first at program files; if viruses are detected therein, the package alerts the user and offers handling options. Afterwards, it asks to do a scan of all files to check for further infection. The package automatically logs every search, any viruses found, and

SUITABILITY TO TASK				
IBM AntiVirus				
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	●	●	●
Removal	●	●	○	○
Prevention	●	●	○	○

includes file date and cyclic redundancy check (CRC) data and is compiled and updated by the package, allows it to perform subsequent scans even more quickly.

The TSR monitors files as they are called and checks them against a subset of the main signature library. If suspicious code is present, the package alerts the user, recommends immediate scanning, and shields the program from the rest of the system by recognizing and disabling the virus. In testing, it allowed us to run an infected program without wreaking havoc on the rest of the system.

AntiVirus does monitor checksums, but doesn't directly identify virus infections this way. Rather, checksum *changes* trigger a heuristic analysis of an altered file, and it's the heuristics that pinpoint infection. This should minimize false alarms. Ordinary changes to your files will not cause annoying tattletale reports—increasing odds that when the AntiVirus alarm goes off you'll take it seriously.

AntiVirus performs triage on infected files: A problematic file is identified as verifiably infected, probably infected, or merely suspicious. If troublesome code matches signatures of known viruses, the package can disinfect the file. If the code is only similar to a known virus, the package cannot disinfect it properly. Most infected files must be ignored or deleted. Master boot records, however, can always be disinfecting since the package assumes the record will resemble most other boot records in the PC world. This can cause trouble for some DOS security packages, which alter the master boot record.

In our testing, AntiVirus caught every virus we threw at it. Files infected with mutated viruses were flagged as probably infected. The TSR detected infections without flagging nonvirus changes. Only the polymorphic Dedicated virus and the

action taken on the file; an option allows the package to log each scanned file. The package was quite respectably quick in going about its business. A database, which

rare Mummy 1.2 virus slipped past the TSR (but it didn't slip past the scanner).

IBM will update the signature database every seven months. Major virus outbreaks will cause earlier updates. AntiVirus's high-performance search engine and extreme unobtrusiveness make it an able protector of your precious files.

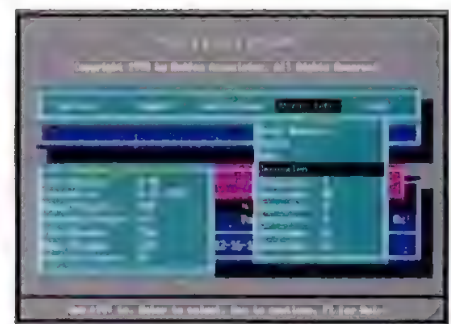
International Microcomputer Software Inc.

VirusCure Plus

BY STEVEN C. M. CHEN

Here's the best advice we can give regarding International Microcomputer Software's VirusCure Plus 2.41 (\$99.95): Wait for the next release. Planned improvements should address some of its current shortcomings. While the package has a few good features, such as TSRs that provide more than virus detection and the ability to remove viruses from memory, the VirusCure Plus standalone scanner let more viruses escape detection than any other product that we tested for this roundup.

There is also no integrity checking to back up the scanner. And, moreover, the program's warning messages don't always remain on-screen long enough for you to read them. To top it off, some of VirusCure Plus's best technologies come from IRIS Software & Computers and McAfee Associates. So you might be better off buying the real thing directly from them.



VirusCure Plus's scanner may be weak in detecting viruses, but it is strong in giving details on the viruses it detects.

FACT FILE

IBM AntiVirus, Version 1.0
IBM Corp., Old Orchard Rd.,
Armonk, NY 10504; 800-551-3579

List price: \$29.95

Requires: DOS version: 640K RAM, 730K hard disk space, DOS 3.3 or later. Microsoft Windows version: 1MB RAM, 1.5MB hard disk space, DOS 3.3 or later, Windows 3.0 or later

In short: IBM AntiVirus provides excellent prevention and detection by using a "fuzzy" search engine to eliminate false alarms. The package contains both a DOS and a Windows version; an OS/2 package is now also available

ON READER SERVICE CARD

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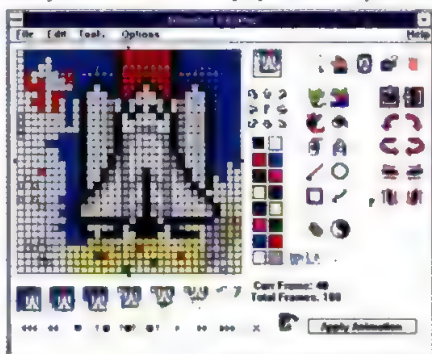
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CIRCLE 041 ON READER SERVICE CARD

Antivirus Software

GETTING STARTED

You will have to run the installation program from a backup disk. A copy of system files are saved to the program disk. Since the installation program doesn't check for viruses, it's recommended that you run the scanner, CURE, before installation.

VirusCure Plus offers two TSRs, PROTECT1 and PROTECT2, for virus protection and for removal or disabling of viruses from memory, respectively. The disadvantage here is that virus-infected files must be loaded into memory in order for the TSRs to take over and disable the virus in memory. A warning message will pop up when the TSRs detect a virus infection being executed. That's the good news. The bad news is that the warning message doesn't always stay on-screen, and we were forced to repeatedly hit the Enter key to return to the menu. All in all, this was a decided nuisance.

The advantage of disabling the virus is that files don't have to be disinfected in order to execute. But because the warning message is fleeting, it would be better if the TSR stopped programs from loading into memory at all.

LIMITED SUCCESS

CURE, the standalone scanner, failed to detect files infected with the Mummy vi-

rus. Only one out of two files infected with the Yankee Doodle virus were detected. CURE also missed all the files infected with the polymorphic Dedicated virus. On the bright side, CURE does provide more detailed information on the viruses than other packages offer.

SUITABILITY TO TASK				
VirusCure Plus				
	POOR	FAIR	GOOD	EXCELLENT
Detection	●	○	○	○
Removal	●	●	○	○
Prevention	●	●	●	○

and an easier-to-use interface. Hopefully, problems that we discovered here will be fixed, and the new features will make International Microcomputer Software's VirusCure worthy of your consideration.

Safetynet Inc.

VirusNet

BY THOMAS M. AMOROSO

VirusNet, Version 2.06, the \$49.95 DOS-based antivirus program from Safetynet, delivered test results strikingly similar to those produced by F-Prot Professional (also reviewed in this story). The reason, we discovered, is that Safetynet licensed F-Prot's engine from developer Frisk Software. Like F-Prot, VirusNet combines outstanding virus scanning and removal with a TSR, VIRSTOP, which in our tests succeeded in detecting all but the polymorphic Dedicated virus.

VirusNet recognizes more than 596 different families of viruses. The program can be run from the command line or through its own easy-to-use interface. Using Safetynet's interface, you can choose to scan, configure, read through a long list of known viruses, or run the setup program.

GET THE NET

Selecting the Scan command brings up a dialog box. Options here include Quick scan (detects but doesn't remove vi-

rus), Heuristic scan (flags both viruses and anything "virus-like," producing only a report of what was found), and Secure scan (scans and lists viruses found and files attacked, then offers to disinfect,

VirusNet allows you to target scanning for specific types of infections, including boot-sector viruses, file viruses, and "Trojan horses."

delete, or rename each infected file).

Having selected the scan method, you can define which drives (including network) or directories to scan. If you select a floppy disk, as each disk is completed, VirusNet automatically asks for a new disk to scan. This is a particularly nice feature.

You can also target scanning for specific types of infections, including boot-sector viruses, file viruses, packed and zipped files, "Trojan horses," joke programs, or user-defined strings.

THROUGH THE NET

With each scan, VirusNet creates a report listing both the specific virus and the virus's family name, the file infected, whether or not disinfection was success-



FACT FILE

VirusNet, Version 2.06

Safetynet Inc., 14 Tower Dr., East Hanover, NJ 07936-3320; 800-851-0188, 908-851-0188; fax, 908-276-6575

List price: \$49.95.

Requires: 384K RAM, 317K hard disk space, DOS 3.1 or later.

In short: Safetynet's VirusNet, Version 2.06, offers a comprehensive scanner that is capable of removing virtually any known virus existing today and allows users to input user-defined strings to help detect future viruses. The TSR that is included is very nearly as good as the scanner.



ON READER SERVICE CARD

FACT FILE

VirusCure Plus, Version 2.41

International Microcomputer Software Inc., 1938 Fourth St., San Rafael, CA 94901; 800-833-4674, 415-454-7101; fax, 415-454-8901

List price: \$99.95.

Requires: 256K RAM, 305K hard disk space, DOS 2.1 or later.

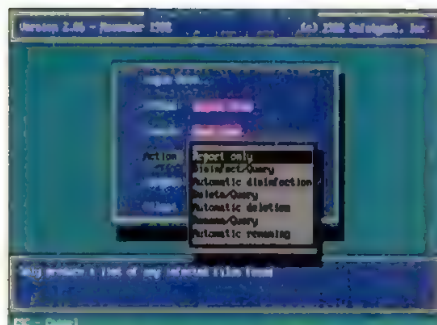
In short: VirusCure Plus 2.41 has a set of TSRs that will detect and disable viruses in memory. A few problems will hopefully be taken care of in the next version of the package



ON READER SERVICE CARD

SOFTWARE

Antivirus Software



VirusNet's easy-to-use interface offers many scanning options, including what type of file (such as .COM and .EXE) and what directories to scan.

ful, and the duration of the scan. On PC Labs' testing, VirusNet detected all 11 sample viruses, successfully removing all except the polymorphic Dedicated virus. It handled the latter by renaming the infected file and alerting the user.

You can download signature library updates from Safetynet's Wildcat bulletin board systems for a quarterly charge of \$30.

The package's TSR, VIRSTOP.EXE, loaded easily and detected viruses at boot-up, locking the system and forcing us to reboot off a floppy. This program

SUITABILITY-TO-TASK				
VirusNet				
	PC	LAN	FILE	EXTENSIVE
Detection	●	●	●	●
Removal	●	●	●	○
Prevention	●	●	●	○

also performed quite admirably in virus removal.

VirusNet can scan network drives. (A network-specific version is also available for \$595, which provides networking administration functions as well.) The product comes with one year of free telephone technical support.

Overall, VirusNet offers a comprehensive scanner capable of both spotting virtually any virus known today and allowing you to input user-defined strings to help detect additional viruses. It falls short of its "parent," F-Prot Professional, only because of its lack of integrity checking. The main consequence of this in testing was that it could not remove the Dedicated virus (although it did detect it), while the F-Prot Professional could. □

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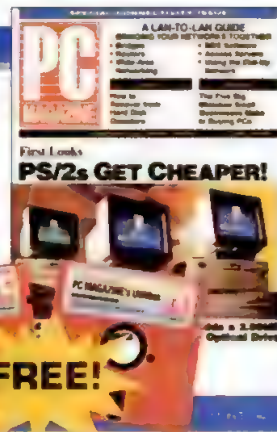
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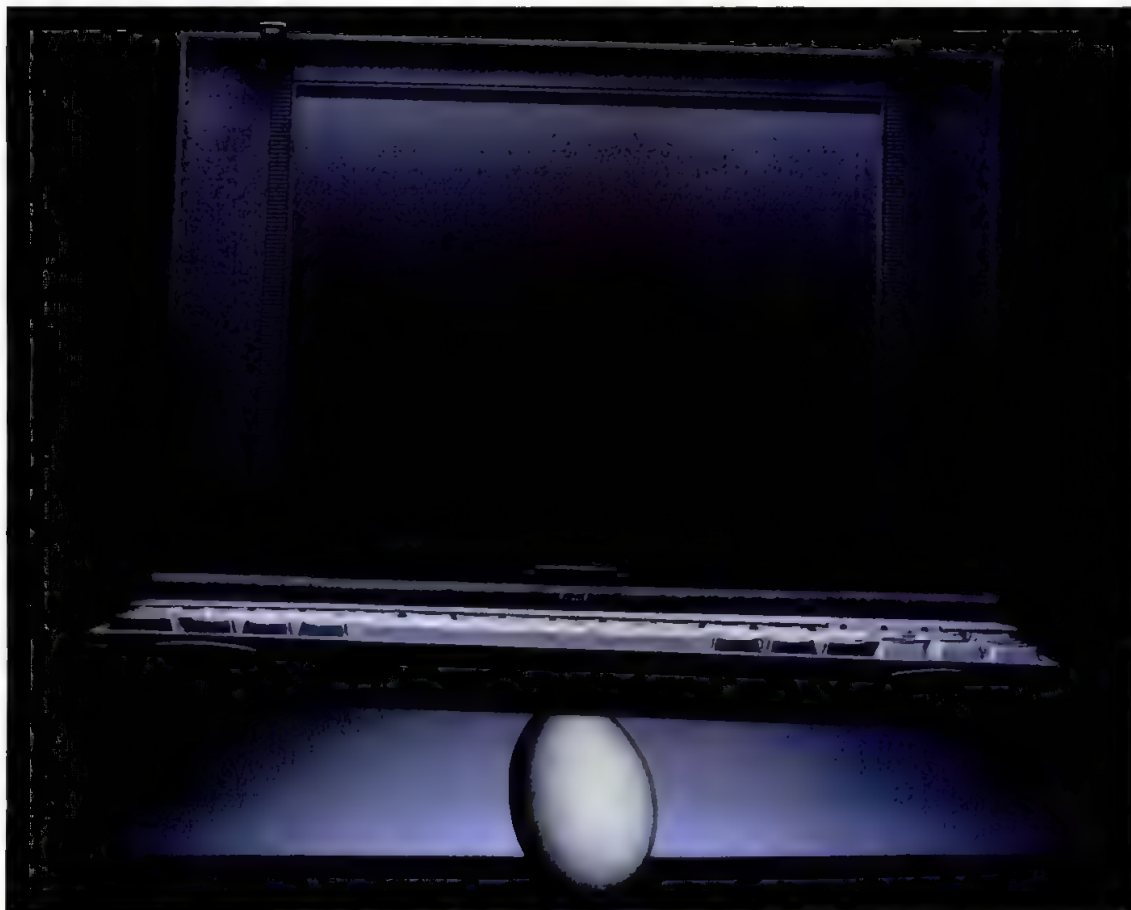
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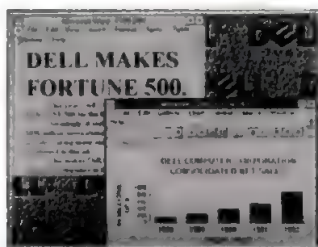
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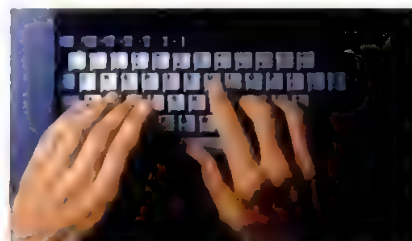
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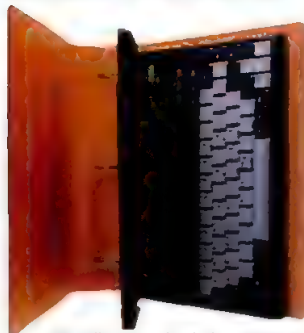
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The Art of Debugging

Why buy a separate debugger when there's already one included with your C compiler? We review 10 debugging tools that take you deeper inside your code.

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Nothing's perfect, least of all software applications. From a programmer's first attempts at a rudimentary code base until (all too often) after a product ships, software is plagued by "bugs"—flaws in a program's logic that cause the application to operate differently than the designers originally intended. These pesky problems can be anything from taking the wrong path in logical flow to inadvertently writing to the wrong memory location. As computer software has become more complex, the bugs that programmers face have

by Rick Knoblaugh

become increasingly thorny. Fortunately for software developers, debuggers—the programs used to uncover these glitches—have become ever more sophisticated, as well.

The debugging tools in this story were all designed for the PC platform. In addition, because compilers from Borland and Microsoft are the most common development vehicles, all of the tools we review support both the Borland and Microsoft debug formats. But that's where the similarities end. In fact, the products in this roundup are not all directly comparable to one another; different types of debugging tools sniff out different types of bugs. Thus, we have organized the tools into four categories: application-level debuggers, system-level debuggers, analysis tools, and syntax checkers.

TYPICAL DEBUGGER CHARACTERISTICS

Application- and system-level debuggers operate as traditional debuggers: They let you load a program into memory and control its execution. *Breakpoints* let you temporarily halt execution and view the contents of memory. *Tracing* or *single-stepping* lets you execute instructions one at a time.

Since your compiler almost assuredly came with some type of debugger, why should you purchase additional debugging tools? Because those bundled tools are not complete debugging solutions (see the sidebar "Comparing the Mainstays: CodeView and Turbo Debugger"). For example, they can't check whether variable references and function-call parameters match, and they can't make sure that you are not overwriting memory. The products in this roundup solve both of these problems and many more.

APPLICATION-LEVEL TOOLS

Application-level debuggers operate at the symbolic level—the level at which your program operates. You refer to



EDITORS' CHOICE

Apples and Oranges

Because these debugging tools are all very different, we thought it would be unfair of us to single out any one of them for an Editors' Choice distinction. Instead, we can make some recommendations within the four categories we examined.

Most compilers come with application-level debuggers, so you need a compelling reason to shell out money for Symantec Corp.'s MultiScope Debuggers for Windows. But MultiScope has some tangible advantages over the debuggers bundled with C-language packages. The only Microsoft Windows-hosted debugger, MultiScope takes full advantage of the graphical interface. It also provides numerous extras, including postmortem debugging and sophisticated class-browsing features for object-oriented programs.

For system-level debuggers, you'll want to choose Soft-ICE unless you are debugging time-sensitive code that requires the hardware assistance that Periscope/EM provides. Soft-ICE costs less than the hardware version of Periscope and can perform virtually all the same functions. And unlike Periscope, Soft-ICE does not use DOS or BIOS services itself, so it can monitor any interrupt-service routine, including keyboard interrupts. Because Soft-ICE is not hardware-as-

sisted, it shares CPU cycles with the program being debugged and is therefore inappropriate for debugging extremely time-sensitive programs.

Bounds-Checker is the best all-around analysis tool. It is completely unintrusive, needs no recompilation or relinking, and is very thorough in its checking. C-Debug's awkwardness may be tolerable only if you are debugging a program on multiple platforms. MemCheck can turn debugging features on and off with an environment variable, so it is handy for debugging at a client site; its feature set is not as complete as those of the other analysis tools, though. As for the specialized tools, SafeHeap and SafeWin, the scope of problems they can find is limited, but they are invaluable aids worth the modest investment.

The one-of-a-kind PC-lint 386 provides syntax warnings that your compiler does not. It can be grueling to customize but worth the effort when it notifies you of errors that you might never have found otherwise.

memory locations by the variable names defined in your program, rather than by raw memory addresses. Such debugging is suitable for most purposes, and debuggers of this kind are provided with virtually every compiler; that is the case with Microsoft CodeView for Windows and

Borland's Turbo Debugger for Windows.

A third-party option in this category is Symantec Corp.'s MultiScope Debuggers for Windows. It provides a postmortem crash facility that lets you see what your program was doing before it died. MultiScope is also unique in that it provides Microsoft Windows-hosted debugging for both DOS and Windows programs.

SYSTEM-LEVEL TOOLS

While application-level debuggers are limited to monitoring programs at the symbolic level, system-level debuggers

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Debugging Tools

can monitor your computer's hardware during program execution, and are thus able to analyze a different class of bugs entirely.

System-level tools are especially useful for debugging TSRs and device drivers, programs which communicate with the peripheral devices attached to your system. TSRs typically contain interrupt service routines—the code that gets control when a device interrupts the processor to signal an event such as a key on the keyboard being pressed. Debugging TSRs can be tricky because the debugger itself may need the hardware that is being used by the program it will debug. Debugging device drivers also presents special challenges. Device drivers are loaded during boot up via `DEVICE=` statements in your `CONFIG.SYS` file. Many systems-level tools can be loaded as device drivers themselves, so they are resident in memory when the device driver you want to check initializes.

The three system-level debuggers examined here go about their tasks in different ways. Hackensack's INTRCPT is a specialized debugging tool for monitoring calls to interrupts; it lets you change calling parameters, return values, or both during program execution. Nu-Mega Technologies' Soft-ICE does not use DOS and BIOS services, and so can trace through any interrupt—including those from the keyboard. And because it "virtualizes" the real-mode DOS environment, it can trap system activity without the need for additional hardware. By contrast, with its add-on board, the Periscope Company's Periscope/EM lets you monitor program execution without the timing interference of the debugger itself.

ANALYSIS TOOLS

C can be a dangerous programming language. Its speed and power have made it the programming language of choice (along with C++) among developers, but there is a tradeoff: C doesn't have the error-checking that other languages such as

Pascal have. So, for instance, if you write to an area in memory where you shouldn't, C will let you do it. But your computer may squawk later, if critical parts of memory have been overwritten.

C can be a dangerous language. Its speed and power have made it the programming language of choice, but there is a tradeoff.

Analysis tools detect errors such as the improper allocation or deallocation of memory, the use of uninitialized pointers, and overruns of memory locations.

Some tools, such as Softran Corp.'s C-Debug and StratosWare Corp.'s MemCheck, add code to your program, which you must then recompile. SeaBreeze Software Systems' SafeHeap provides a monitoring replacement library that links with your code; no recompilation is necessary. For the Windows environment, SeaBreeze also offers SafeWin, which monitors most

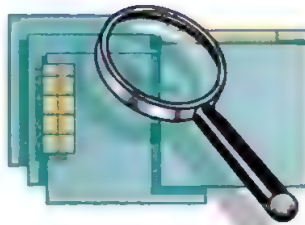
of the Windows' API calls for bad memory handles and invalid parameters.

Nu-Mega's Bounds-Checker provides an unintrusive means of monitoring memory access. You load your program from within Bounds-Checker and then monitor its execution. Unlike other analysis tools, with Bounds-Checker you don't need to change a single line in your source code, nor do you have to relink with a special set of libraries.

SYNTAX CHECKERS

Syntax checkers check your source code for statements that are syntactically legal, but may not do what you intended. Compilers provide some warnings, but nothing compared to those generated by Gimpel Software's one-of-a-kind PC-lint 386. It can be a bear to use, but the information it provides can be a life-saver.

Debugging is a formidable task, but the products reviewed here can boost your debugging capabilities and make your work much easier.



Application-Level Tools

Symantec Corp.

MultiScope Debuggers for Windows

BY NEIL J. RUBENKING

Symantec Corp.'s MultiScope Debuggers for Windows, Version 2.01, combines a Microsoft Windows-hosted runtime debugger with a masterful post-mortem analysis facility in one \$379 package. One version of the product provides support for Borland languages (C++ 3.0 and 3.1, Turbo Pascal for Windows, Version 1.5), while another supports Microsoft C/C++, Version 7.0 (MSC 7.0). A third version supports MSC 6.0 and a wide variety of CodeView 3.0-compatible compilers. Symantec also offers MultiScope Debuggers for DOS and OS/2.

As a "soft" application-level debug-

ger, MultiScope doesn't interfere with other programs, unlike the application-level tools bundled by Borland (Turbo Debugger for Windows) and Microsoft (Microsoft CodeView for Windows). These are "hard" Windows debuggers: They run in character mode and completely take over the system. MultiScope's Windows interface supports an amazing graphical display of linked data and of C++ classes. Like CodeView's Dr. Watson and Turbo Debugger's Winspector, MultiScope's MED (Monitor Execution and Dump) records the status of any program that crashes; but its Crash Analyzer facility makes MultiScope's post-mortem dump data much more useful than that of the other two packages.

OF WINDOWS, BY WINDOWS, FOR WINDOWS

MultiScope's main runtime debugger is meant for applications; it can debug 16-bit Windows programs and DLLs, but

■ Comparing the Mainstays: CodeView and Turbo Debugger

by Neil J. Rubenking

Every year there are more programming tools on the market, and there are more varieties of programming tools. The choices are enough to make your head spin. Fortunately, if you happen to be one of the vast majority of programmers who rely on either Microsoft or Borland language compilers, there is one choice that you don't have to ponder. If you use Microsoft products, your standard debugger is CodeView; if you use Borland

products, it's Turbo Debugger. (Turbo Debugger provided CodeView compatibility in its early days, but not anymore.) Both products exist in DOS and Windows versions; we'll look at the Windows versions here. Note that Microsoft CodeView for Windows, Version 4.0, is available only as an element of Microsoft language packages (Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080). The current Turbo Debugger, Version 3.2, is also available only as a bundled product, despite the existence of the Borland product called Turbo Debugger and Tools; the version of Turbo Debugger in that package is frozen at Version 2.0 (Borland International Inc., 1800 Green Hills Rd., Scotts Valley, CA 95067; 800-331-0877, 408-461-9000).

BASIC DEBUGGING SKILLS

Turbo Debugger for Windows and Microsoft CodeView for Windows are

both "hard" Windows debuggers: When the debugger is active, all other processes, including Windows itself, shut down. Both of these packages manage all of the necessities of debug-

ging—tracing through code, setting breakpoints, watching variables, and so on. You can use a second monitor with either package, and both support serial remote debugging as well. (Turbo Debugger also supports remote debugging via a

network.) The two products have similar limitations, too. Neither one is suited to debug 32-bit programs or DLLs, kernel device drivers, or virtual device drivers (VxDs). Still, they will be perfectly satisfactory for debugging applications.

The user interface of a hard Windows debugger is character-based, because Windows isn't available to provide a graphical interface. CodeView and Turbo Debugger both have a menu-driven, mouse-aware, multiwindow interface that is very similar to that of the corresponding DOS debugger. CodeView even provides a Commands window for those familiar with its older command-driven inter-

face. In Turbo Debugger, switching from the debugger display to the program's screen means going from character mode to graphics mode, a process that can produce an annoying flash on the screen and an audible snap. CodeView uses techniques licensed from Nu-Mega Technologies to map the display into a graphical window, thus avoiding the flash. On the other hand, Turbo Debugger's interface includes substantially more types of windows, giving you a wide range of views on the program's code and data. Each Turbo Debugger window has a local menu; click the right mouse button or press Alt-F10 and you can view a pop-up menu of commands specific to the current window.

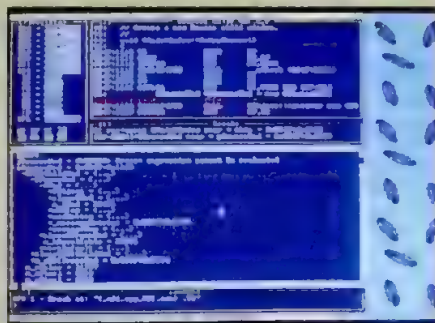
BREAKPOINTS, PLAIN AND FANCY

The simplest type of breakpoint breaks out to the debugger when a certain line of source or assembly code is reached. Conditional and pass-count break-

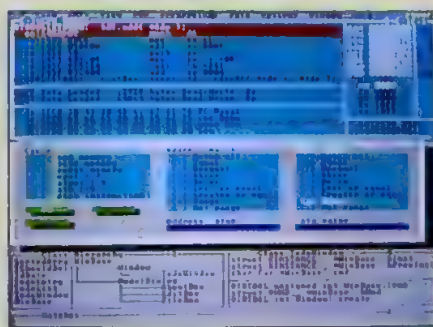
points are variations on this type, breaking when an expression is true or when the breakpoint is reached a certain number of times. CodeView and Turbo Debugger also include global breakpoints that break any time an expression becomes

true or a variable's value changes, or when a particular Windows message is received. Besides simply breaking out to the debugger, a Turbo Debugger breakpoint can log a text string or ex-

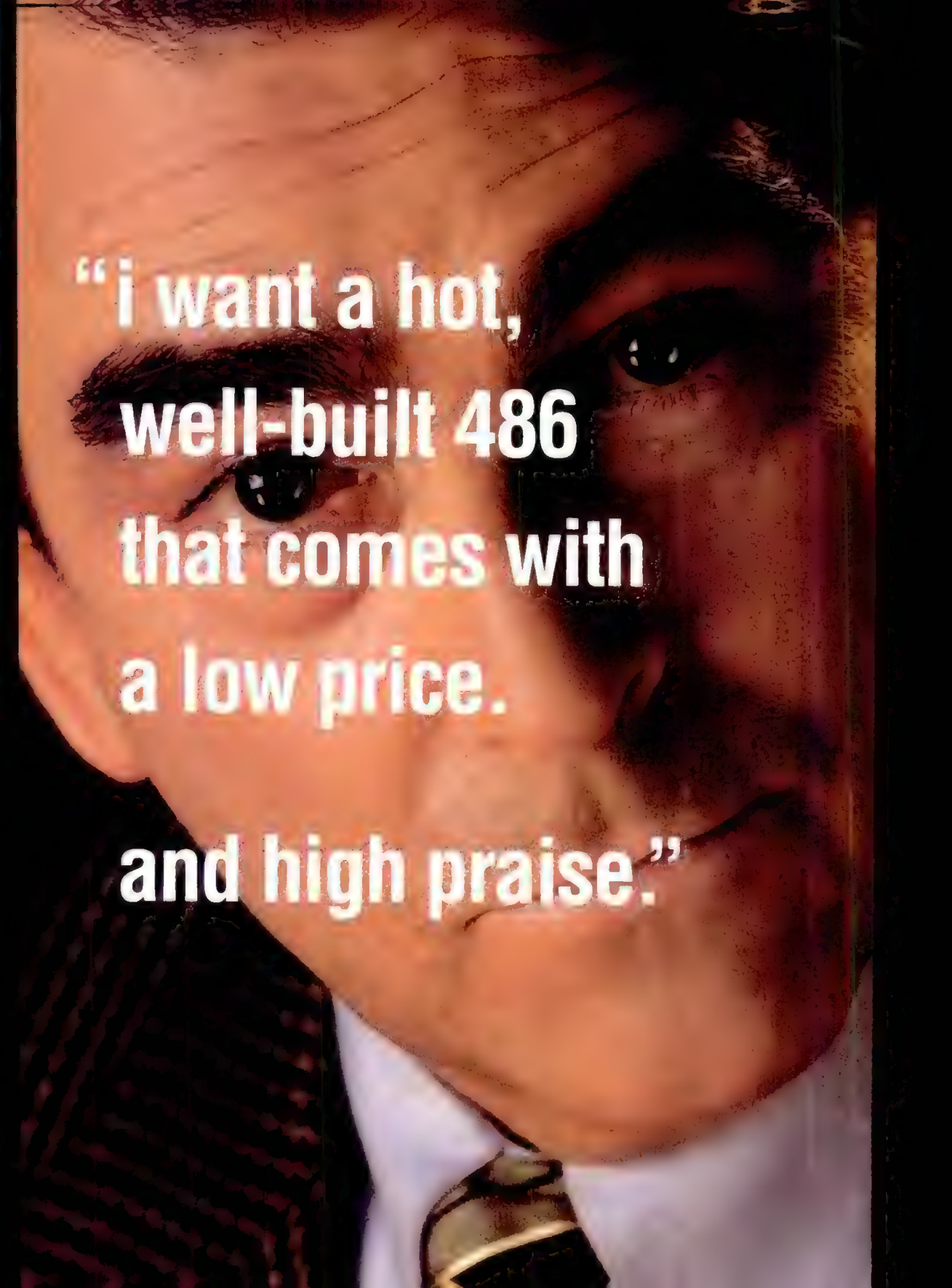
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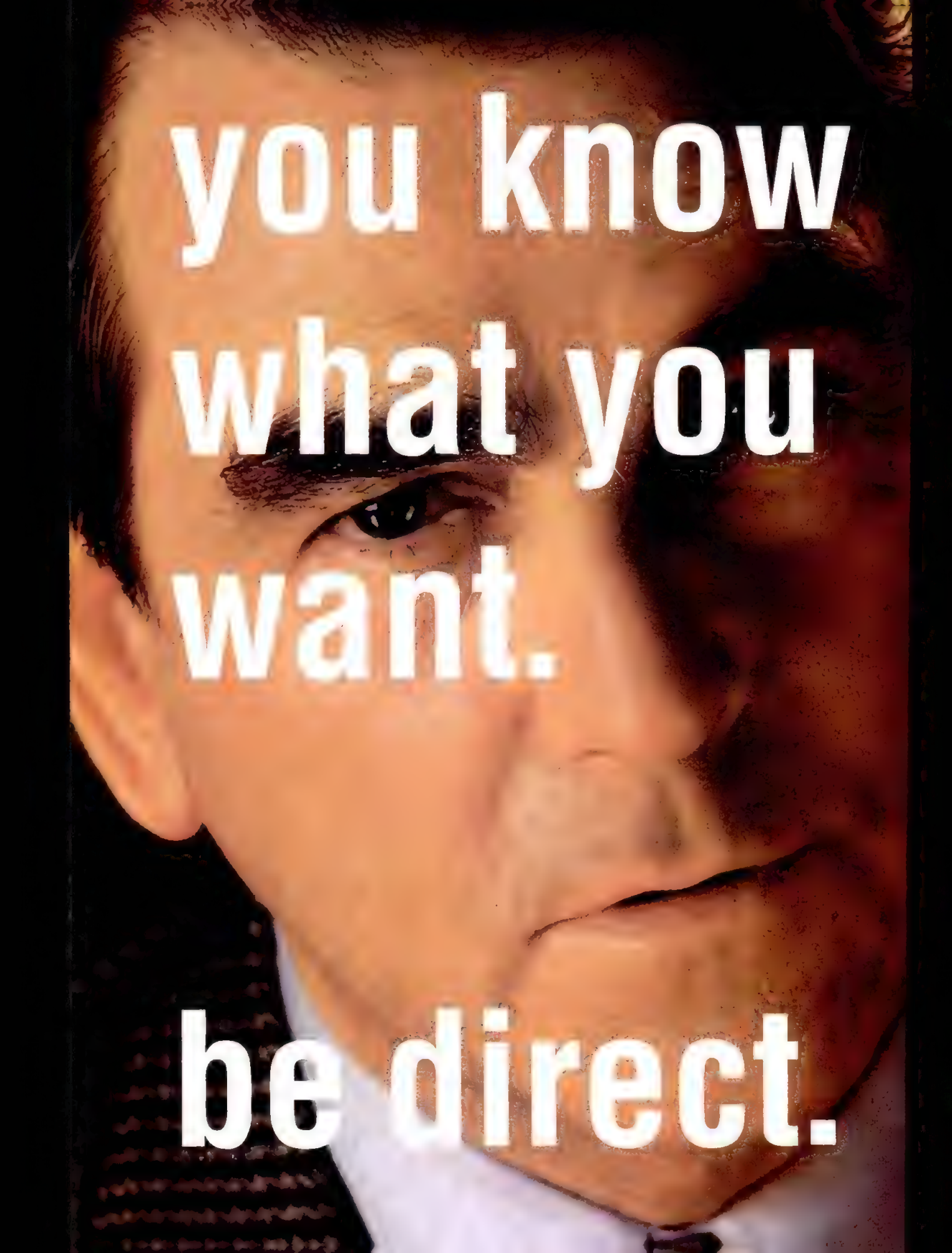
The handy Watch window of Microsoft CodeView allows outline-style expansion of structured data types during debugging.



Support for object debugging is evident in the Class Hierarchy tree display and Class Inspector window sported by Borland's Turbo Debugger.



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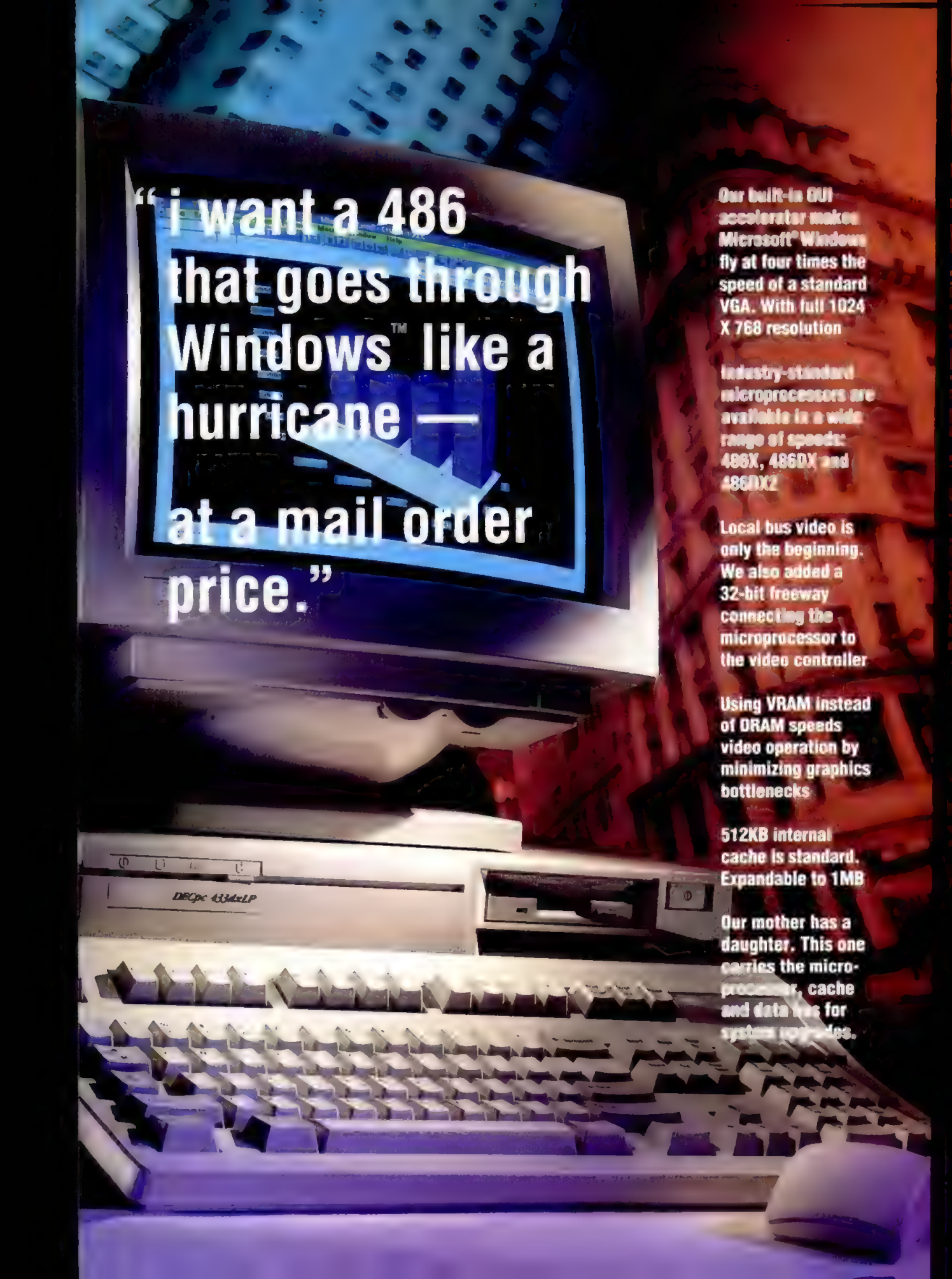
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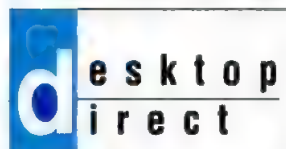
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50-MHz 486DX2 average	487	6,430	276	2.539	5.51
Dell System 486D/50 (486DX2/50)	450	5,525	241	4.272	1.58



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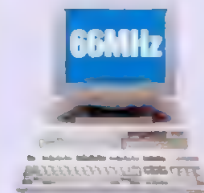
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		Advanced Logic Research Inc. Flyer 320T 4DX/33	AST Research Inc. Bravo 4/33 Model 123B	Dell Computer Corp. Dimension 486DX/33	Digital Equipment Corp. DECpc 433dx LP	IBM PC Co. PS/1 Model 2155-S76	Zenith Data Systems Z-433DX Model 200
Overall weighted score		3.6	3.5	2.4	4.0	2.8	3.4
1. Price vs. performance (30%)		4	4	2	4	3	4
2. Performance (25%)		3	4	2	4	3	3
3. Expendability (25%)		4	3	3	4	2	3
4. Serviceability (10%)		3	3	2	4	3	4
5. Quality of construction (10%)		3	2	3	4	3	3

1. Overall performance relative to cost (comparative among these six machines). 2. Overall comparative system performance in all tests. 3. Support for processor, memory, storage and expansion board upgrades. 4. Ease of processor, memory, storage and expansion board upgrades. 5. How well the system is assembled (including case design, power supply and tools required for assembly).

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The Mainstays

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pression, enable or disable other breakpoints, or execute a line of "splice code." Splicing lets you add the line dynamically while you're debugging, rather than making you add the line, recompile your code, and start the debugging process over again. CodeView breakpoints can execute splice code or any other CodeView command (including commands to enable or disable other breakpoints).

A 386 or better CPU supports specialized hardware breakpoints, most notably watchpoints that trigger the debugger when a range of memory gets changed. Turbo Debugger supports hardware-assisted watchpoints, but CodeView doesn't. Turbo Debugger takes the concept farther: It includes hardware breakpoints that activate on port I/O or on any memory access of any region of memory. It also lets you specify a range of addresses for which the hardware breakpoint will be active, from all of memory down to a single instruction.

ICING ON THE CAKE

A number of specialized data views give Turbo Debugger a kind of data debugging. Inspector windows display any type of data, and a single keystroke allows you to descend into a structured data type or follow a pointer. Your program's object hierarchy (with TPW or BC++) is available for study in a window, and inspector windows display any class or object instance. The closest that CodeView comes to this facility is its ability to open and close objects and complex data structures in an outline fashion.

If you have ever spent a long time

hand-tracing program execution, only to go past an important point, Turbo Debugger's reverse execution will thrill you. When you enable reverse execution (via the local menu of the Execution History window), you can trace backward through your code, at the source level or at the assembly level. There are limitations, however:

you can only step backward through code that you have already stepped through going forward, and you simply cannot reverse certain instructions (such as port I/O). Still, reverse execution can be a life saver.

If you've gotten the impression that

Turbo Debugger simply does more than CodeView, you're right. Except for the mapping of the debugger's character-mode display to graphics, Turbo Debugger does everything CodeView does and then some. Other special Turbo Debugger features include history lists for almost every input line, automatic symbol-name completion, and a clipboard with which you can copy and paste symbols, addresses, or data between different views. Still, you won't actually be choosing between the two debuggers, except as part of the larger choice of what programming environment you wish to use.

Both CodeView and Turbo Debugger are perfectly suitable for application debugging, and either one can be supplemented by the specialized products mentioned in this review. You just may find, however, a greater need for add-ons when you use CodeView. One possible add-on is CV/ICEing, a new product from The Periscope Company that should be released by the time you read this article. CV/ICEing is designed to enhance CodeView with some additional breakpoint options. □

If you've ever spent a long time hand-tracing program execution, Turbo Debugger's reverse execution will thrill you.

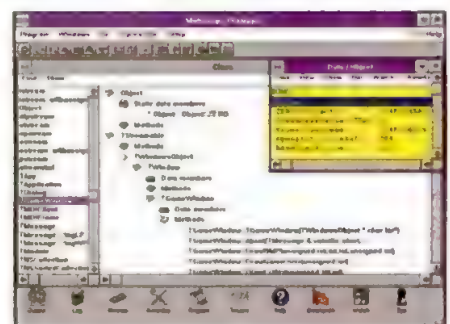
not 32-bit programs, kernel device drivers, or virtual device drivers (VxDs). It is a standard Windows Multiple Document Interface (MDI) application, with up to 16 different views of the program code and data. Initially, the Call Chain, Data/Object, Module, Procedure, and Source Code windows are open, with the rest available at the touch of a hotkey. Where appropriate, views are linked. For example, double-clicking on a procedure in the Call Chain window brings up the procedure's source code. The MultiScope toolbar holds icons for 16 common debugging functions, and each window has a local menu with commands that are appropriate to that view.

A fully Windows-hosted debugger avoids the constant swapping between graphics mode and character mode that's typical of a hard Windows debugger, but it also takes up space on the screen. MultiScope's GUI can shrink to a VCR-style control bar with buttons for the most common debugging functions. It also includes a Spy window to watch Windows messages in real time or to send messages to a window.

Soft debugging does have disadvantages. Since other programs continue to run, your program may miss events—for example, DDE (Dynamic Data Exchange)—while stopped at a breakpoint. When a soft debugger won't do, MultiScope provides a character-based hard-mode debugger. After being spoiled by the luxury of the Windows-hosted debugger, however, you'll use the hard debugger as little as possible.

HE'S DEAD, JIM

When a program crashes with an application error or some other runtime excep-



The class browser in MultiScope represents objects as folder icons, data fields as Rolodex files, and methods as notepads.

Debugging Tools

FACT FILE

MultiScope Debuggers for Windows, Version 2.01

Symantec Corp., 10201 Torre Ave.,
Cupertino, CA 95014-2132; 800-999-8846,
408-253-9600; fax, 408-253-3968



List price: \$379; upgrade from version 1.0, \$99

Requires: 286-based PC or better, 4MB RAM, 3MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.x.

In short: The unique status of

Symantec's MultiScope Debuggers for Windows as a fully Windows-hosted application debugger is both a blessing and a curse. On one hand, it uses the familiar Windows user interface and has an unparalleled graphical display of data. On the other hand, it can't debug at the system level and seems more crash-prone than its hard-mode competitors



ON READER SERVICE CARD

tion, MultiScope's MED goes into action, creating a PMD (post-mortem dump) file that contains a complete record of the state of the program; optionally, the PMD file can include specified DLLs, the Windows screen, the Windows kernel, and the global heap. Loading the PMD file into MultiScope's Crash Analyzer module gives you nearly all of the features that the runtime debugger has except for the ability to step through the code. You can examine the exact instruction that caused the exception, trace the call stack, examine the data structures, and so on.

MED also responds to the Ctrl-Alt-SysRq key combination by terminating the currently active program and creating a dump file for it. You can use this feature to break out of a stuck program and locate the problem. C and C++ programs can also incorporate a special library to force the MED facility to produce a dump when a runtime error has occurred, or at the discretion of the programmer. Symantec offers separate licensing for MED, so that developers can distribute it to test sites.

DATA STRUCTURES AS ART

The graphical display of data structures is the hallmark of MultiScope. Just high-

light a data structure in the Data/Object window and press Ctrl-G to bring up the Graphic Data window. While it's true that other debuggers permit tracing through data structures, without the visual display that MultiScope offers some errors might go unnoticed.

A C++ program that is based on an application framework is likely to have a rich and complex class hierarchy. It's often difficult to determine just where a method or data member is declared. With MultiScope, an outline-style class browser can display the hierarchy, while the Data/Object window supplies details

on a particular window object.

MultiScope gives you the freedom to view and track your code and data in ways that a hard Windows debugger cannot. It is handy for simple application-level debugging, and essential for sorting out data-structure problems. Soft-mode Windows debugging, however, is difficult to implement and can be unreliable—be prepared for occasional system crashes. And while you will delight in being able to do most of your work in the Windows GUI, you'll need a hard-mode system-level debugger to take on the problems MultiScope can't handle.



System-Level Tools

Hackensack

INTRCPT

BY BOB FLANDERS

Interruptions are an everyday part of life. If the phone rings, you answer it. If the alarm clock buzzes, you wake up (at least for a while). And if your child screams, you run to see why.

Similarly, your computer drops whatever it's doing to respond to "interrupts"—demands for attention that come from hardware (like the keyboard) or from software. When your PC receives an interrupt, it responds by running a routine that performs an appropriate action according to the interrupt requested. These routines are called interrupt service routines, or *interrupt handlers*. And like any other software, interrupt handlers need to be debugged.

Debugging interrupt handlers and the code that calls them can be time-consum-

ing and frustrating. But Hackensack's INTRCPT, Version 1.1n (\$99.00), can help. This 36K TSR excels at intercepting, reporting, and modifying parameters when a user-specified interrupt is called. Through INTRCPT's easy-to-use pop-up menus (which appear when you press a hotkey combination) you can select an interrupt to intercept, display a memory map, display an interrupt function database, invoke INTRCPT's debugger, and



INTRCPT's pop-up menu lets you monitor, trap, and log a specific interrupt, an interrupt and a function, or an interrupt, a function, and a subfunction.

configure a number of aspects of INTRCPT's operation. There is no on-line help, but the 30-page user's manual should answer most of your questions. Also, there are no trace or disassembly features in the version that we reviewed, but an update that will include these is scheduled for release by the time you read this issue of *PC Magazine*.

INTERCEPTING INTERRUPTS

After selecting which interrupt to monitor, you can limit the interception to specific functions and subfunctions of that

► SUMMARY OF FEATURES

Debuggers

In alphabetical order by category

■ = YES □ = NO

	APPLICATION-LEVEL TOOLS			SYSTEM-LEVEL TOOLS		
	Microsoft CodeView for Windows (bundled with Microsoft C++ 7.0)	MultiScope Debuggers for Windows	Turbo Debugger for Windows (bundled with Borland C++ 3.1)	INTRCPT	Periscope/EM for DOS	Soft-ICE
List price	\$499	\$379	\$495	\$99	\$3,590	\$386
Platforms:						
DOS	Separate version	Separate version	Separate version	■	■	■
Microsoft Windows	■	■	■	□	Separate version	Separate version
OS/2 2.0	□	Separate version	□	□	Separate version	□
Debug formats:						
Borland Turbo Debugger	□	■	■	□	■	■
Microsoft CodeView 3.0 and 4.0	■	Separate version	□	□	■	■

Special Program Types

Interrupt debugging						
Trap calls to interrupts	□	□	□	■	□	□
Debug/trace into interrupt vectors	□	□	□	□	■ (limited ability)	■
View/modify calling parameters	□	□	□	■	□	□
View/modify returned parameters	□	□	□	■	□	□
Debugs DOS TSRs	N/A	N/A	N/A	■	■	■
Debugs DOS device drivers	N/A	N/A	N/A	□	■	■
Debugs Windows VxDs	□	□	□	N/A	N/A	N/A

Basic Debugging Features

Breakpoints:						
Global break on data in or out of range	■	□	■	□	■	■
Break on hardware-port I/O	□	□	■	□	■	■
386/486 hardware breakpoints	□	■	■	□	■	■
Logic breakpoints	□	■	■	■	■	■
Tracing and interactive execution:						
Slow-motion automatic trace	■	■	■	□	□	□
Inspect and change variables	■	■	■	□	■	■
Inspect and change memory location	■	■	■	■	■	■
View memory as desired data type	■	■	■	□	■	■
Data structure browsing	■ (limited ability)	■	■	□	□	□
Post Windows message	□	■	□	□	□	N/A
View 386/486 32-bit registers	■	□	■	□	■	■
View 80x87 registers	■	■	■	□	□	□
Display local and global heaps	■	□	■	□	□	□
Reverse execution	□	□	■	□	□	□
Hardware-assisted debugging	□	□	■	□	■	□

Additional Features

Class browsers supported	None	BC++, MSC7	BC++, TPW	None	None	None
Protection for memory	□	□	□	□	■	■
Debugs remote applications:						
Via serial port	■	■	■	□	■	■
Via LAN	□	■	■	□	□	□
Searching:						
For string in source code	■	■	■	□	□	■
For instructions in memory	□	□	■	□	□	□
For data patterns in memory	■	□	■	■	■	■
For function by name	□	■	■	□	□	□
Post-run debugging						
Hardware breakout button	□	□	□	■	■	□
Postmortem dump	■	■	■	■	□	□

N/A—Not applicable. The reviewed version of the product does not support this operating environment.

Debugging Tools

interrupt. For example, INTRCPT can intercept all calls to interrupt 21h (DOS calls), then narrow it down to interrupt 21h, function 44h (IOCTL calls), or further narrow it to interrupt 21h, function 44h, subfunction 08h (IOCTL query device-removable calls.)

When a program or hardware event calls the selected interrupt, INTRCPT can respond in one of three user-selectable modes: log, monitor, or trap. In log mode, INTRCPT adds a log entry to an ASCII text file. Each log entry can have a short or long format. In short format, INTRCPT simply records the calls as they occur. In long format, INTRCPT also records the entry and exit register contents and, if requested, performs a short memory dump based on the address in a register pair. When in monitor mode, INTRCPT displays the last four calls in ticker-tape format at the bottom of the screen.

Finally, when in trap mode, the INTRCPT debugger is invoked when the interrupt is called. The debugger includes functions to display, change, or fill memory; display or change registers; compare memory blocks; or even call a different interrupt. You can also load and execute another program such as DOS's DEBUG, provided you have set aside sufficient memory. When the interrupt handler finishes processing a call, you can examine or modify the results before returning to the calling program.

INTERRUPT DATABASE

INTRCPT includes a database with over 1,000 interrupt functions from BIOS, Btrieve, DOS, NetBIOS, and Novell's NetWare. The database includes the interrupt's number, function, subfunction, and description. It also notes if INTRCPT should dump memory upon entry to and exit from an interrupt, and records the register pair (ES:DI, DS:BX, and so on) that contains the starting address for the dump.

INTRCPT annotates log listings and trapped interrupts using information from the database. You can also load the

database into memory and scan it from INTRCPT's pop-up menu, making short work of trying to remember which DOS function performs which operation. The database requires an additional 50K of expanded memory (if available) or conventional memory.

A breakout switch, which is installed in an expansion slot and which lets you revive INTRCPT even after an unrecoverable program crash, is available at an extra cost. The switch generates a nonmaskable interrupt which launches INTRCPT, so you can look around memory once before rebooting your machine. This feature is handy when your system locks up and will not respond to the keyboard.

SOME LIMITATIONS

INTRCPT's major flaw is its inability to trace through an interrupt handler. You can't watch the interrupt routine executing line by line; you can only stop when the interrupt is invoked or when it completes execution. Moreover, INTRCPT only allows interception of one interrupt at a time. So you can't, for example, monitor interrupt 21h, function 40h (DOS write to file) and interrupt 13h (BIOS

disk I/O) simultaneously. This limitation interferes with debugging interrupts that call other interrupts. Programmers will also want to note that INTRCPT 1.1n requires a VGA adapter: INTRCPT reprograms the VGA hardware to display a 26th line, which serves as INTRCPT's status line.

If you should have a problem, however, Hackensack's tech support responds very quickly. We obtained immediate technical assistance on three calls including one that we placed on a Saturday afternoon.

As it stands now, INTRCPT is a useful tool for debugging interrupt software. Once the disassembly and tracing features are added, this product may well become a standard tool in the software developer's toolbox.

The Periscope Company Inc.

Periscope/EM

BY RICK KNOBLAUGH

The first step in installing Periscope/EM is to remove your CPU chip. The thought is alarming to even the most hardware-proficient programmers. But if you need to debug time-sensitive programs, you'll want to take the risk.

The hardware components of Periscope/EM, Version 5.31, consist of a CPU-specific "POD" and a trace buffer board with a breakout switch. The breakout switch lets you generate an NMI (nonmaskable interrupt), which will invoke Periscope at any time, even when your program is hung and interrupts are disabled. The POD plugs directly into your motherboard, in the spot where your CPU used to be before you yanked it out. The CPU then plugs into the POD and is connected to the trace buffer board via a ribbon cable. This allows Periscope to directly monitor CPU events and then transfer the event log to the hardware trace buffer so you can go back and see what happened.

The other important function of the hardware is to transfer the debugger processor load from your computer's CPU to the trace buffer board. This is the feature that enables you to debug time-sensitive programs—programs that make heavy use of interrupts, such as communi-

FACT FILE

INTRCPT, Version 1.1n

Hackensack, P.O. Box 181386, Arlington,
TX 76096; 817-572-0345



List price: Version 1.1n (reviewed here) \$99, Version 1.2n (available January 1993) \$129
Breakout switch \$59

Requires: 512K RAM, VGA monitor, DOS 3.3 or later

In short: INTRCPT lets you monitor

interrupt invocations and display entry and exit parameters. Although not a perfect product, INTRCPT provides many of the tools necessary to debug interrupt software. At an additional cost, a breakout switch is available that lets you resuscitate a dead system and take a last look around before you reboot.



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\$2699 (Lease as low as \$92.31/mo.)*

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Elegance 486 ZXP EISA Workstation

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Elegance 486 ZXP EISA Server

80486DX/33 processor; upgradable to other i486 processors and OverDrives; supports P24-T; 128K cache; 8MB RAM; 340MB SCSI hard drive; tower case; 1.2MB or 1.44MB floppy drive; 14" VGA monochrome monitor; 101-S keyboard

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Server Option #1:

Elegance™ ZXP 486DX2/50 EISA; 16MB RAM; Adaptec 1740 SCSI controller; 525MB hard drive; 1.44MB floppy drive; Intel Ethernet Express 32-bit Thinnet interface card; VGA video adapter; 14" VGA monochrome monitor; installation of Novell NetWare

\$4999 (Lease as low as \$165.97/mo.)*

Server Option #2:

Elegance ZXP 486DX2/66 ISA; 8MB RAM; 340MB IDE hard drive; 3.5" and 5.25" floppy drives; Intel Ethernet Express 16-bit Thinnet interface card; VGA adapter with 1MB RAM; 15" SVGA color monitor; Windows for Workgroups installed

\$3999 (Lease as low as \$136.77/mo.)*

Data Entry Workstation: SlimLine ZXP 486SX/25; 4MB RAM; 100MB hard drive; 1.44MB and 1.2MB floppy drives; local bus VGA with 1MB RAM; Intel Ethernet Express 16-bit Thinnet card; 14" SVGA color monitor

\$1699** (Lease as low as \$62.86/mo.)*

Advanced Application

Workstation: Elegance ZXP 486DX2/66; 8MB RAM; 240MB IDE hard drive; 1.44MB and 1.2MB floppy drives; VESA VGA video adapter with 1MB RAM; Intel Ethernet Express 16-bit Thinnet card; 14" SVGA color monitor

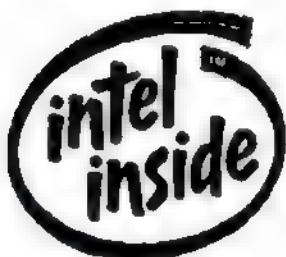
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Debugging Tools

cations programs. Since no CPU cycles have to be allocated to the debugger, the application that you are debugging can be run at full speed, without interference from another process. Software-only debuggers slow system operations since the CPU must also execute the debugger, and so the normal flow of events is altered.

WORTH THE EFFORT

Periscope supports breakpoints using the 80386/486 debug registers. Real-time hardware breakpoints and data capture can also be generated on specified address and data values. There are configurable windows for data, code, watches, registers, and stack. The register window enhances your debugging efficiency by highlighting registers that are modified by the current instruction. A software trace-buffer display logs the path taken through your program as you encountered breakpoints and executed trace instructions. This feature and the stack window help you remember how you got to where you are. Additionally, you can set up record-definition templates for frequently displayed memory areas.

You can load the Periscope TSR entirely into extended memory if you have a memory manager that supports QPMS, the Qualitas/Periscope Memory Specification (386MAX; BlueMAX, Version 5.11 or later; and NetRoom, Version 2.2 or later, for example). This lets you load the debugger software into extended memory and write-protect it so that errant programs cannot corrupt it.

A utility, SYSLOAD.SYS, optionally loads Periscope at CONFIG.SYS time, so it is available to debug device-driver initialization calls. Other Periscope utilities include TS (which generates a *symbol file*—a table of all the variables in a program and where they reside in memory) and RUN (which loads programs and symbols).

Although function keys can be configured to be CodeView-compatible, the mapping is not flawless. The F3 key will

FACT FILE

Periscope/EM, Version 5.31

The Periscope Company Inc., 1197
Peachtree St., Atlanta, GA 30361;
404-875-8080

List price: Periscope/EM, Version 5.31 (software only),



\$295 Model IV hardware trace buffer board. Rev 1 with 2K buffer (25 MHz), \$1,295; Rev 2 with 16K buffer (33 MHz), \$2,795 CPU POD 80386 Rev 1L, \$500. 80486 Rev 1L, \$650

Requires: 386DX-based PC or better, 300K extended memory, DOS 3.0 or later, memory manager that supports Qualitas/Periscope Memory Specification

In short: A powerful hardware-assisted memory-resident debugger. Periscope/EM provides real-time hardware breakpoints and the ability to capture a trace buffer of CPU event information. Periscope is a valuable tool for debugging system-level problems in extremely time-sensitive applications. With the additional hardware, however, the price may be too steep for some.



ON READER SERVICE CARD

not toggle you between source, mixed, and unassembled displays. This is done with the "US", "UB" and "UA" commands. Also, you can't point to an instruction and use F7 to go there as with Microsoft CodeView.

Periscope has good on-line help, and the product is accompanied by a quick reference card and comprehensive manual. Excellent technical support is free-

of-charge and available via telephone and BBS.

One of this package's most impressive features is its hardware trace buffer. The Periscope Model IV Rev 2 trace-buffer board contains 16K of trace memory in which CPU events

are stored in records of 80 bits each. By using this in conjunction with hardware breakpoints, you can capture the CPU events that have occurred before, after, or before and after a breakpoint location. This powerful

capability is indispensable if you need to debug time-critical code peppered with many interrupts. You can let the interrupts occur unhindered since the hardware trace buffer is keeping track of all that has occurred.

The trace buffer can be displayed in raw mode (shows only the CPU cycle data), unassembled mode (shows only disassembly format), and trace mode (a combination of both). The raw mode displays the address, data, type of CPU event, CPU cycle count since the previous trace buffer record, and the trace buffer record sequence number. These last two items are invaluable if you ever need to analyze the time spent fetching code or accessing memory and I/O space.

If you put a trace-buffer record at the top of the display, enter "#", and add another trace-buffer record sequence number, Periscope will show the number of CPU cycles used by the events within those records. This lets you see how much time these events are taking in the execution of your code. You can also type "*" to toggle the display of flushed instructions (instructions that were fetched, but not executed due to jumps or returns).

PERISCOPE/32 FOR WINDOWS

A Microsoft Windows 3.x version of the Periscope software—Periscope/32 for Windows, Version 5.30 (\$395)—is also available. Currently, Periscope/32 is a software-only product. Hardware support is expected in the first half of this year. Periscope/32 also differs from the DOS version in that two systems must be used: You run Periscope/32 on a DOS host and Periscope/Remote for Windows (included) on the Windows target.

Periscope/Remote is implemented as a Windows virtual device driver (VxD) that communicates with Periscope/32 via a serial link. The product allows you to debug Windows VxDs, Windows device drivers, drivers and programs running in the DOS box, and other Windows 3.x Enhanced mode system software.

Save for an actual ICE (in-circuit emulator) which would cost ten times as much, Periscope/EM with the accompanying hardware may be the best debugging tool available for time-sensitive, interrupt-laden programs. Its ability to capture CPU event information and



Periscope/EM displays Data, Watch, Register, Stack and Code windows.

Debugging Tools

show all the activity that has occurred can be a life-saver when debugging time-critical programs.

Nu-Mega Technologies Inc.

Soft-ICE

BY RICK KNOBLAUGH

Like Periscope, Soft-ICE, Version 2.5, is a system-level debugger that monitors your computer at the hardware level as your program executes. But unlike Periscope, Soft-ICE can accomplish its magic without hardware assistance, making it a much cheaper solution. It utilizes the 80386/486 protected mode and virtual 8086 mode to "virtualize" the real-mode DOS environment. That is, it traps all system activities, including interrupts, and transparently routes them to their appropriate real-mode destinations. However, since Soft-ICE shares CPU time with the code you are trying to debug, you may not be able to debug extremely time-sensitive programs with it as you can with Periscope.

Another difference between the Soft-ICE and Periscope packages is that the Soft-ICE package does not use BIOS or DOS services, and therefore does not compete with programs that do. This is an important advantage because it is dif-

ficult to debug a program that takes over the keyboard interrupt with a traditional debugger, as the debugger itself needs the same keyboard services. With Soft-ICE 2.5 you can debug device drivers, interrupt-service routines, or even DOS.

VIRTUALIZING REALITY

Since Soft-ICE is the first to see all system activity as part of the virtualization process, it boasts many special capabilities. Breakpoints can be set on interrupts, memory accesses, and I/O accesses. Soft-ICE can protect its own memory space from being overwritten by other programs. If you choose, Soft-ICE can trap all instructions, placing them in a back trace buffer where they can be reviewed or replayed or both in a simulation mode. The clearing of interrupts can be virtualized so that even if an errant program executes a CLI assembler instruction and then loops endlessly, you can still hotkey into Soft-ICE to debug the problem. The product also makes use of the 80386/486 debug registers. This enables execution breakpoints to be generated in ROM as well as RAM.

One of the most powerful aspects of Soft-ICE is the ability to debug device drivers, which are loaded from CONFIG.SYS at boot-up time. The MAP command shows you where all drivers, TSRs, and the like have been loaded. By using the segment address displayed by MAP, combined with the desired offset, the BPX or G commands can be used to break on driver code execution.

How do you debug a driver's initialization routine when the driver is loaded before your computer even finishes booting up? No problem. If you are debugging the initialization logic for the first time, the best way is to place an INT 3 instruction in your code to activate Soft-ICE. Another method, assuming your initialization code at least allows your driver to become resident, is to hotkey into Soft-ICE, set an execution breakpoint in the initialization code, and then use the Soft-

ICE BOOT command. The BOOT command performs a warm boot-up, but retains Soft-ICE and any breakpoints you have set. This terrific feature lets you launch programs that are run at boot-up time under control of the debugger.



Soft-ICE's BOOT command lets you debug boot-time code such as drivers that are loaded in CONFIG.SYS.

FLEXIBLE INTERFACE

Soft-ICE is a memory-resident debugger that loads into extended memory as a TSR or as a device driver. If you load Soft-ICE as a device driver, it can coexist with other extended-memory managers such as HIMEM while still

allocating the extended memory necessary for symbolic and source-level debugging, back-trace buffers, and expanded memory. However, Soft-ICE cannot exist with expanded-memory managers.

Programs are loaded into memory for debugging via LDR.EXE, a utility provided with Soft-ICE. Symbolic information and source code will be displayed if there is CodeView-compatible or Turbo Debugger-compatible information in the .EXE file.

Pressing a configurable hotkey will pop up Soft-ICE in an on-screen window. Window sizes can be adjusted, and separate subwindows can be set up for registers, code, data, and commands. The information in the data window is updated each time you activate Soft-ICE. This is particularly useful if you're debugging device drivers and want to view an area in memory (say, a command-request block) upon the occurrence of each breakpoint. Output can be directed to the primary screen of your PC, or to an alternate screen, printer, or COM port.

Soft-ICE can coexist and work with a real-mode debugger such as Microsoft CodeView for Windows, under which you can load an application, hotkey into Soft-ICE, and define a breakpoint. Within Soft-ICE, the ACTION command indicates that when the breakpoint occurs, an interrupt is to be generated which will activate CodeView. This lets you supplement your debugger's features with Soft-ICE's specialized capabilities.

FACT FILE

Soft-ICE, Version 2.5

Nu-Mega Technologies Inc., P.O. Box 7780,
Nashua, NH 03060-7780; 603-889-2386

List price: \$386

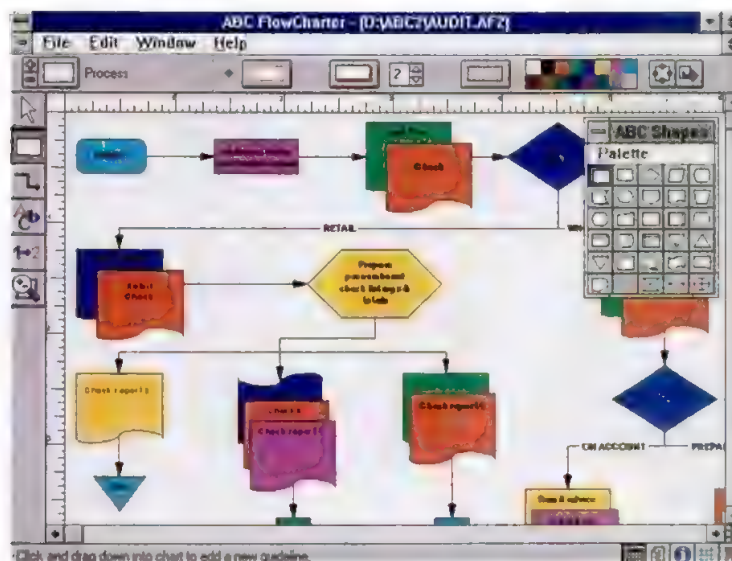
Requires: 386SX-based PC or better, 256K extended memory, DOS 3.0 or later

In short: Soft-ICE is a powerful memory-resident debugger that uses the 80386/486 CPU features

to "virtualize" the real-mode DOS environment. Thus, it provides hardware-like debugging capabilities, such as setting breakpoints on I/O or memory accesses, but at a much lower price than true hardware-assisted debuggers. It is the perfect tool for debugging device drivers, TSRs, or other system-level software, and can also coexist with—and complement—your existing real-mode debugger.

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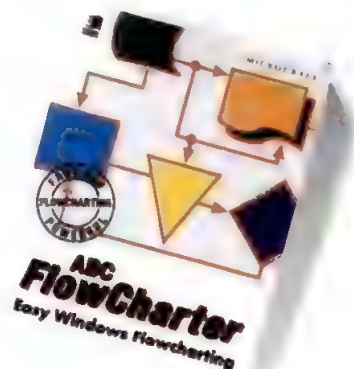
DBMS Magazine
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Debugging Tools

Command syntax is easy to remember with Soft-ICE, as the software displays the syntax for a given command as you type. If you require more information, a good on-line help feature is provided as well as a quick reference card. The user manual thoroughly explains the "virtual machine" concepts and how Soft-ICE capitalizes on these capabilities.

SOFT-ICE/W

The Microsoft Windows version of Soft-ICE, Soft-ICE/W, is a superset of Soft-ICE for DOS. It extends the same powerful system-level debugging capabilities to the Windows 3.x environment. Soft-ICE/W can be used to debug Windows applications, device drivers, Windows 32-bit virtual device drivers (VxDs) that exe-

cute at privilege level 0, and DOS software running in DOS boxes. It also lets you view internal Windows information such as the VxD map and the protected-mode data structures such as the GDT, IDT, and page tables. Since Soft-ICE/W actually loads Windows, you can get control of your system at a very early stage of initialization. Considering the complexities of Windows and the capabilities Soft-ICE/W provides, it is even more impressive than its DOS counterpart.

Soft-ICE does an exquisite job of providing powerful system-level debugging capabilities, and at an extremely reasonable price. Unless you need to debug time-sensitive programs that require hardware assistance, Soft-ICE will meet all of your system-level debugging needs.

of the application by other programs (TSRs or device drivers, for instance).

Bounds-Checker doesn't require any source-code modifications or the linking of new library files. However, you do have to recompile your program with the debugging options enabled, and you must generate a detailed map during the link. Microsoft CodeView and Borland Turbo Debugger information formats are supported. The only potential problem is if the program uses the "pascal" or "fastcall" function calling conventions; if so, those functions must be changed to the standard C calling convention "cdecl" in order to use Bounds-Checker's stack trace facility.

Debugging with Bounds-Checker is easy: Simply launch the program that you wish to debug from within Bounds-Checker. When a memory access error is detected, Bounds-Checker displays a pop-up window identifying the type of error, procedure name, module name, source file, line number, and (if available) the source code. If no source code is available (for example, if the problem occurred in a library routine that wasn't compiled with any debugging information), Bounds-Checker will display the registers and disassembled code.

You can instruct Bounds-Checker to use a second monitor to display the pop-up window, or you can have it log all problems to a disk file without displaying the window. This is handy when an application is being tested by a non-programmer.

EXCEPTION-AL OPTIONS

The pop-up window has options that will ignore the error and continue, log the error and continue, log the error and write-protect the memory area being accessed, or add the memory access to the exception file. (An *exception file* defines memory accesses which are valid and those which Bounds-Checker should ignore.)

Bounds-Checker maintains both an exception file for individual programs and a global exception file for memory accesses common to all programs tested with Bounds-Checker. Because the line where the error occurred is often not where the problem originated, an especially useful feature is the ability to browse through the "stack list"—the rou-



Analysis Tools

Nu-Mega Technologies Inc.

Bounds-Checker

BY REX CONN

In debugging the memory-access problems that plague C programs, Bounds-Checker, Version 2.0 (\$249), takes a different approach than the other analysis tools we review here. Rather than inserting any source code or replacing the program's memory-related runtime library functions, the package uses the memory paging and protection features of the 80386/486 processors and the debugging information generated by your compiler (C or C++) or assembler to intercept memory accesses outside a program's data area. And if you need any additional code-debugging capability, you can com-

bine Bounds-Checker with Nu-Mega Technologies' Soft-ICE debugger (also reviewed here).

Because it runs in protected mode, Bounds-Checker is not compatible with most other protected-mode programs such as Microsoft Windows or OS/2. It is, however, compatible with most DOS extended-memory managers, including 386MAX, HIMEM, and QEMM-386.



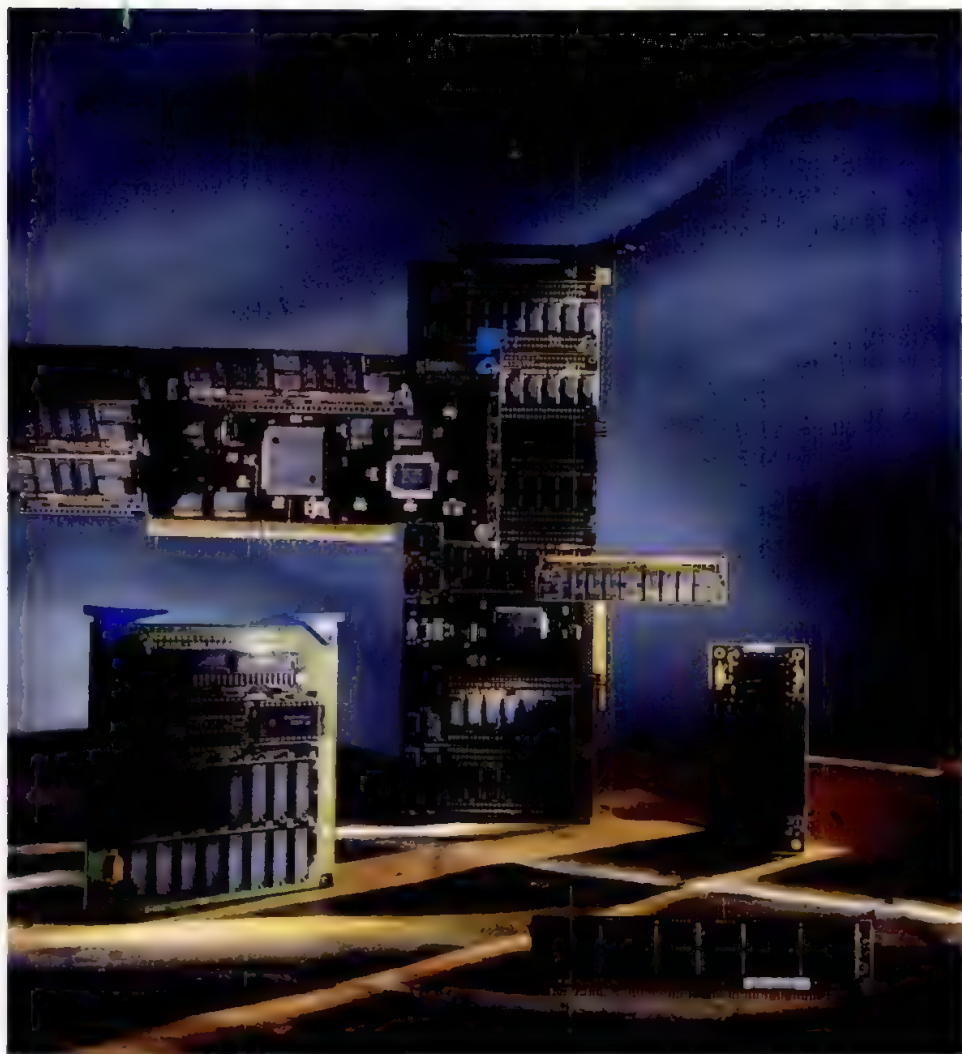
When Bounds-Checker intercepts a memory error, it pops up a window pinpointing the offending line of code.

The folks at Nu-Mega are currently working on a new version of Bounds-Checker for Windows programmers.

MEMORY ACCESS MAVEN

Bounds-Checker detects nearly every type of memory-access error imaginable, including allocation failures,

buffer overwrites, memory leakage, and invalid pointers. It will also flag processor exceptions, the execution of code outside of the program, and even the overwriting



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► SUMMARY OF FEATURES

Debuggers

Products listed in alphabetical order

■ = YES □ = NO

ANALYSIS TOOLS					
	Bounds-Checker	C-Debug	MemCheck	SafeHeap	SafeWin
List price	\$249.00	\$249.00	\$139.95	\$95.00	\$249.00
General Features					
Works without source-code changes	■	□	□	■	■
Works without additional libraries	■	□	□	□	□
User can direct output to:					
File	■	■	■	■	■
Printer	□	■	■	□	■
Second monitor	■	□	□	□	■
Platforms:					
DOS	■	■	■	■	□
Microsoft Windows	□	□	Separate version	□	■
OS/2	□	■ (text only)	□	□	□
Other	None	QNX, Unix, VAX	Mac, Unix	None	None
Languages:					
C	■	■	■	■	■
C++	■	□	■	■	■
Assembly	■	□	□	□	■
Pointer Checking					
Validates pointers:					
Uninitialized or corrupted pointers	■	■	■	■	■
NULL pointers	■	■	■	■	■
Out-of-range errors in application:					
Local (stack) variables	■	■	■	□	■
Static (heap) variables	■	■	■	□	■
Allocated (heap) variables	■	■	■	□	■
Out-of-range errors in library:					
Local (stack) variables	■	■	■	■	■
Static (heap) variables	■	■	■	■	■
Allocated (heap) variables	■	■	■	■	■
Freeing bad blocks:					
C (malloc/free)	■	■	■	□	■
C++ (new/delete)	■	□	■	□	■
Not freeing blocks (memory leakage):					
C (malloc/free)	■	■	■	□	■
C++ (new/delete)	■	□	■	□	■
Out of memory	■	■	■	□	■
Memory access outside data segment	■	■	□	■	■
Overwrite by external program	■	□	□	□	□
Windows Programming					
Checks local and global memory	N/A	N/A	N/A	N/A	■
Traps fatal Windows errors	N/A	N/A	N/A	N/A	■
Checks API parameters and return values	N/A	N/A	N/A	N/A	■
Tracks object creation and deletion	N/A	N/A	N/A	N/A	■
Enables error-triggered callbacks	N/A	N/A	N/A	N/A	■

N/A—Not applicable. The reviewer's version of the product does not support this operating environment.

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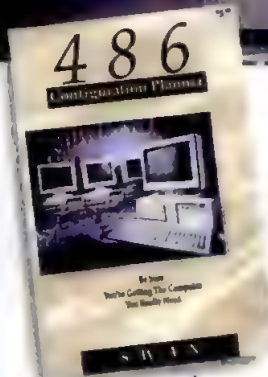
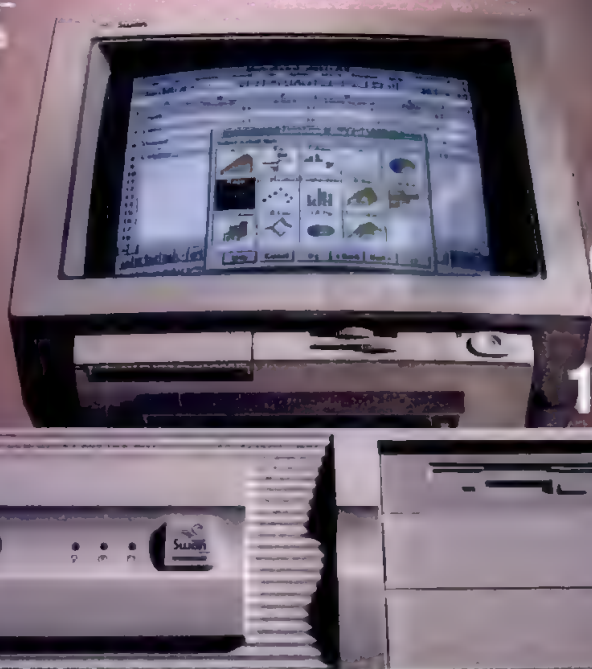
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Debugging Tools

FACT FILE

Bounds-Checker, Version 2.0

Nu-Mega Technologies Inc., P.O. Box 7780,
Nashua, NH 03060-7780; 603-889-2386;
fax, 603-889-1135

List price: \$249

Requires: 386-based PC or better, 256K hard disk space, 256K extended memory

In short: Bounds-Checker is an easy-to-use protected-mode debugger dedicated to catching

memory I/O problems. Without requiring any changes to your source code, Bounds-Checker can find problems that no other memory checker (or, in many cases, even a full-blown debugger) can detect

 ON READER SERVICE CARD

times in your application that were called to reach the current line of code.

SMART CHECKER

Many DOS applications need to read or write to memory outside their data area; for example, when reading BIOS variables from low memory or when writing to video memory in high memory. Bounds-Checker includes a "Smart" mode, in which it refers to its knowledge base to determine whether that particular memory access is valid. This feature greatly reduces the number of valid memory accesses that would otherwise be flagged as errors.

When the program ends, Bounds-Checker notifies you of any allocated memory that wasn't freed (memory leakage) and it reports to you any interrupt pointers which were changed by the program but not restored.

JUST ABOUT PERFECT

There's not much to criticize about Bounds-Checker. The Bounds-Checker documentation is well-written and quite thorough. Technical support is available through the Nu-Mega BBS, by telephone, or by fax.

It does appear that Nu-Mega put their effort into the internals and not into the interface, however; the pop-up window and its menus are functional but unexciting. There is no mouse support, nor is there any way to change the default col-

ors. But these are very minor quibbles about a very good program.

Bounds-Checker successfully combines ease of use with the ability to debug even the most complex memory access problems. DOS programmers (and soon Windows programmers) will find it a valuable addition to their toolkits.

Softran Corp.

C-Debug

BY REX CONN

C-Debug, Version 2.1, offers both extensive memory checking and portability across a number of operating systems. No support for C++ is provided, but this \$249 C memory checker from Softran Corp. will find problems in pointer and array accesses in both the heap (dynamic and static) and the stack. Softran Corp. offers C-Debug versions for DOS, OS/2 (text mode only), VAX VMS, and several flavors of UNIX. But user be warned: The generic approach adopted by C-Debug requires some compromises in its ease of use and in memory overhead.

C-Debug uses a preprocessor that analyzes each source file and automatically generates an extensively modified version of the source for itself. This modified version contains function calls to the C-Debug routines for each pointer or array reference; the modified source files are then compiled and linked with the C-Debug routines. When the program is executed, it checks every pointer and array that your program uses for validity. If C-Debug detects an error, it displays the name of the source file and the line number where the error occurred, and then terminates the program.

OVERHEAD AND EXTRA WORK

While this approach is thorough, it does increase the memory requirements significantly. C-Debug will typically increase program size by a minimum of 20 percent to 30 percent, depending on the memory-checking scheme used and the number of pointer and array operations that your application contains. For those programs already pushing the DOS memory limit, this extra overhead may make C-Debug unusable. C-Debug's use of the preprocessor also requires you to

edit your make files so that each source file will be processed before it is passed to the compiler.

Since C-Debug checks all memory accesses, it will generate an error message for some normal DOS programming techniques, such as reading the BIOS data area or writing to video display memory. Disabling the memory checking for these operations requires some tedious editing to insert C-Debug preprocessor pragmas around the problem spots in the source code.

TWO WAYS TO GO

To keep the increased overhead to a minimum, C-Debug offers two memory-checking schemes. The simpler scheme (the default setup) keeps a list of all available buffers, with the address and size of each. Memory accesses are checked against this list for validity. If the address is found within the list and the buffer is large enough for the operation being checked, C-Debug will pass it on.

This approach is quicker and has less overhead than the second scheme; it will also find the types of errors that crash your program. But this approach will not catch an error where a pointer is referencing the wrong buffer or when a dynamic memory block is "orphaned" (that is, no valid pointers remain that reference the block).

The second and more detailed scheme keeps a cross reference of all program variables and all available buffers. Each

FACT FILE

C-Debug, Version 2.1

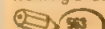
Softran Corp., One Naperville Plaza, #455,
Naperville, IL 60563; 800-462-3932,
708-505-3456; fax, 708-505-3457

List price: \$249

Requires: 1MB hard disk space

In short: C-Debug can catch almost all potential heap and stack problems, and it is available for several different operating systems. But it's more difficult to

configure and use than most, and it adds significant memory overhead to your programs—a problem when working under DOS

 ON READER SERVICE CARD

Debugging Tools

memory access is then checked against this list. This second approach requires the preprocessor to insert significantly more code into the program and is more likely to report errors with unusual but valid C operations, such as negative array indices.

Function-definition libraries are provided for the Borland, MetaWare, Microsoft, and Watcom DOS compilers. C-Debug also includes a utility to create additional function-definition libraries for unsupported compilers.

EXPERIENCE A MUST

The C-Debug manual, although reasonably complete, is terse and assumes that the reader is an experienced programmer. It mixes documentation for all of the different environments that C-Debug supports; this is handy if you're developing on more than one platform, but makes specific information for a single operating system more difficult to find. We found technical support from Softran to be good; help is available either via telephone, fax, or through their BBS.

THOROUGH, BUT A TOUGH CLIMB

C-Debug will catch nearly every type of memory allocation or overwrite problem that you may encounter. However, its complexity, memory overhead, and the substantial modifications required of the source code make it more difficult to use in the DOS environment than the other memory checkers that we reviewed here. If you don't need C-Debug's compatibility across multiple operating systems, you may want to take a look at one of the DOS-specific programs instead.

StratosWare Corp.

MemCheck

BY REX CONN

MemCheck, Version 2.1 (\$139.95), StratosWare Corp.'s memory-checking library for C and C++, focuses its attention on catching common errors programmers make when working with dynamic memory (memory allocated by C runtime library routines such as `alloc`, `calloc`, and `realloc`). MemCheck will report on buffer overwrites (writing before the beginning or after the end of a buffer), memory

FACT FILE

MemCheck, Version 2.1

*StratosWare Corp., 1756 Plymouth Rd.,
#1500, Ann Arbor, MI 48105; 800-933-3284,
313-996-2944; fax, 215-584-4266*



List price: \$139.95

Requires: 600K hard disk space

In short: Reliable and easy to use, MemCheck is best suited for finding dynamic memory allocation, deallocation, and overwrite problems. But it doesn't detect everything, if you need extensive stack or static heap checking you should look elsewhere.

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leakage (failing to free allocated memory), invalid (null or uninitialized) pointers, and memory-allocation failures (running out of memory).

EASY ON, EASY OFF

Using MemCheck requires adding only one line (`#include <memcheck.h>`) to each source file. A utility program is included which will do this automatically for a specified group of files. Two routines (`mc_startcheck` and `mc_endcheck`) are then added to the program, and the program is recompiled and linked with the MemCheck library. The library overhead will increase the program size a relatively modest 7K to 15K. Although `mc_startcheck` and `mc_endcheck` are the only functions required for memory checking, MemCheck includes more than 20 additional functions if you want to customize it for your application.

MemCheck stores 28 bytes of information in memory about each allocation being tracked. If your program does thousands of allocations and memory is tight, you can use the alternate (but slower) disk-tracking library to reduce overhead to 4 bytes per allocation.

At runtime, `mc_startcheck` checks the environment for the variable `MEMCHECK`. If it is defined, MemCheck will be active; otherwise the MemCheck routines are ignored. This feature and MemCheck's minimal overhead allow you to send a debug version of your program to client sites and only activate the memory-checking routines if a problem arises.

When MemCheck detects an invalid memory access, it returns information on the file, line number, and function where the buffer was allocated; if the access occurred on one of the monitored routines such as `memset`, `sprintf`, `strcat`, or `strcpy`, it returns the file, line number, and function where the invalid access is about to occur. MemCheck normally writes this information to the display, but you can opt to log it to a file or send it to your own error-reporting function. MemCheck continues the program execution after displaying an error.

In its default configuration, MemCheck only checks the dynamically allocated memory. It can be configured to also check global (heap) and local (stack) variables, but this is an awkward process requiring that you add MemCheck routines to your source code. You must register the name and length of each variable you want to monitor, and then unregister the variable when it is no longer used. This approach is tolerable if you only want to watch a few specific variables, but becomes unmanageable as the number of global or local variables grows.

SIMPLE BUT SOLID

The MemCheck manual is well-written and organized, and, when combined with MemCheck's own simplicity, gets you up and running fast. Technical support is available on CompuServe and Internet, or at StratosWare's toll-free number.

MemCheck is available in versions for the Borland, Intel, Microsoft, and Watcom compilers, as well as for the Macintosh. StratosWare also offers a \$179.95 version of MemCheck for Microsoft Windows 3.0 and 3.1. The Windows version includes all of the features of the DOS version, and additionally monitors the Windows memory allocation APIs (such as `LocalAlloc` and `GlobalAlloc`).

MemCheck has fewer features than some of the other products reviewed here, and doesn't offer the detailed checking of all memory accesses performed by other packages. MemCheck does offer ease of use and solid performance with minimal overhead, and it is a good choice for monitoring dynamic memory usage or for creating a program with embedded (but normally disabled) debugging code.

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The Luggables

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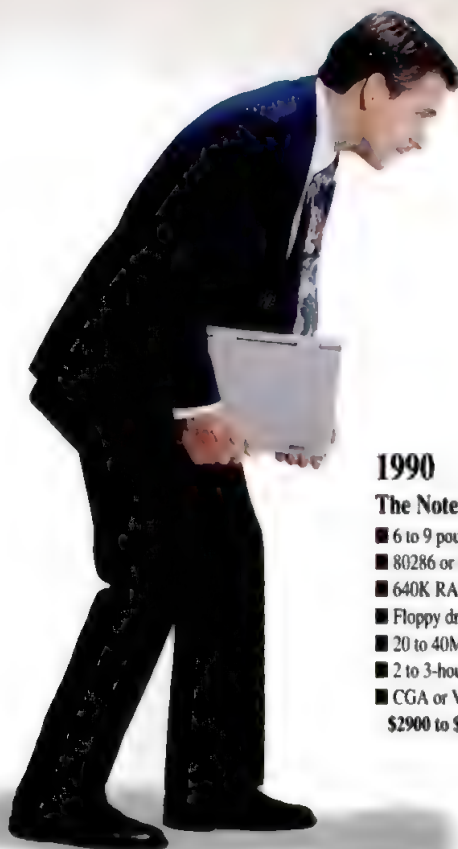
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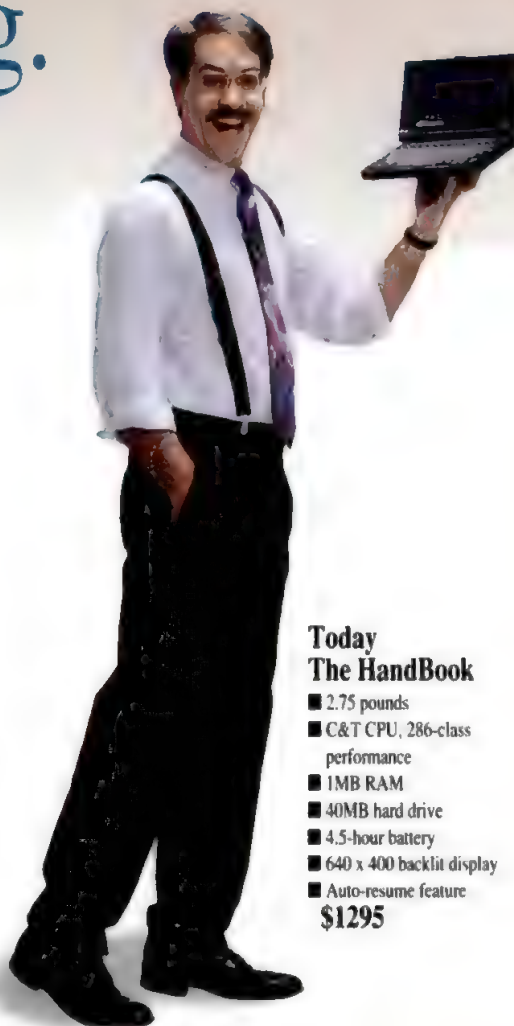
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SeaBreeze Software Systems

SafeHeap

BY BOB FLANDERS

The next time you have a problem with a C program's use of string or buffer manipulation routines, try using SafeHeap, Version 1.5, from SeaBreeze Software Systems. Not intended as a comprehensive debugging solution, this \$95 specialty tool provides a fast and simple method for checking parameters passed to C library routines that move or update strings or buffers. (Your C compiler will only perform type checking on these parameters.)

Like its sibling, SafeWin (also reviewed in this roundup), SafeHeap checks library calls. But while SafeWin checks calls to the Microsoft Windows API, SafeHeap checks calls to the C runtime library. SafeWin's sophisticated monitoring of several hundred Windows API calls far outstrips the simple bounds-checking performed by SafeHeap, but the costlier SafeWin can't monitor a DOS program.

COLORING INSIDE THE LINES

SafeHeap replaces 31 standard C library routines (such as strcpy, memcpy, setmem, strcat, and strlen) with versions that validate the passed addresses before

performing the requested action. You need only relink your program. Then when you run it, SafeHeap will produce a report noting any suspicious calls and will disallow the action. So, for example, if a call requests a write beyond the boundaries of an array (such as copying 15 bytes to a 10-byte field), SafeHeap will record the call in a report file and will not move the bytes.

Since SafeHeap's functions do not perform the requested operation when they are passed an invalid address, your program may not operate as you expected. For example, your program may work properly in spite of an error that moves six characters into a five-character global character array. But when SafeHeap detects the error and skips the move, another portion of your program may "break" since the string does not contain the expected data.

THINKING ON ITS FEET

Fortunately, SafeHeap takes this possibility into consideration. SafeHeap will optionally perform suspicious operations based on the setting of a DOS environment variable. There are four settings for the environment variable: shut off SafeHeap validation, validate address and only report errors, report validation errors and skip the operation (the default), or report one validation error and abort the program.

SafeHeap also provides functions to enable or disable address verification, to register new addresses (making them valid for reads and writes), and to determine if a read or write will cause an error. By using these functions, you can fine-tune the way in which SafeHeap monitors your program.

Since SafeHeap can significantly slow down a program, you can isolate debugging to a few routines by using the SafeHeap Enable and Disable functions. When disabled, SafeHeap does not significantly impact a program's performance. To use these special functions, however, you must change your source

code and recompile your program, which can become time-consuming.

WHAT SAFEHEAP MISSES

SafeHeap uses a link map to determine the valid memory addresses. As a result, it does not know about automatic variables, non-global static variables, or specific hardware memory addresses such as

the video memory, the EMS frame-buffer memory, or the BIOS communications vector memory.

If you want to ensure that an access lies within the boundaries of an automatic variable, you must register the address and length with SafeHeap by using a SafeHeap function call. Again,

this means modifying the source code and recompiling the program. Similarly, you can inform SafeHeap about hard-coded addresses used by hardware buffers, communications vectors, and the like. You simply build a file that contains the start address, length, and description of the areas, and SafeHeap will recognize accesses to those areas as valid. If you do not register these addresses before using them in a SafeHeap validated routine, however, SafeHeap will not recognize the access as valid.

SafeHeap does not detect errors caused by direct assignment of a value to memory; it only checks addresses passed to the library routines that SafeHeap replaces. Finally, SafeHeap does not work with Windows because SafeHeap assumes that all addresses are real-mode addresses.

ROLL YOUR OWN

SafeHeap comes with full source code and a 24-page manual describing SafeHeap's operation and functions, as well as instructions for implementing additional validation routines. If you have a function that moves or modifies memory, you can easily build a version of that function which performs SafeHeap-style address validation.

If you have a problem with SafeHeap, you can contact SeaBreeze technical sup-

FACT FILE

SafeHeap, Version 1.5

SeaBreeze Software Systems, 1330 Hwy. 206,
Skillman, NJ 08558; 609-924-6793

List price: \$95

Requires: DOS 3.1 or later. 286-based PC or better and 1MB extended memory recommended

In short: SafeHeap is an easy, effective way to check the addresses your program passes

to C runtime library string- and buffer-manipulation routines. By simply relinking your program, you can verify that your program's calls to library routines do not overwrite code, exceed the boundaries of memory regions, or access unallocated memory. SafeHeap produces an error report in an ASCII text file



ON-READER SERVICE CARD

Debugging Tools

port via telephone, CompuServe, or a tech-support BBS, though we found that it can sometimes take a few hours to get a response. Still, SafeHeap is an inexpensive product that thoroughly addresses a very specific set of problems. By simply relinking your program, you might discover the cause of a nagging problem, or even uncover a problem that you didn't know you had.

errors: RIPs, NFY_LOGERRORs and NFY_LOGPARAMERRORs. It can display a stack trace for each error condition, and let you immediately identify the errant function and the module in which it lies. It can also intercept calls to OutputDebugString, calls which are ordinarily routed to a debugger.

Whenever SafeWin encounters a problem in your program, it will respond

by displaying a message box with the name of the failed function, or it can show a dialog box that includes the function and a stack trace. The dialog includes buttons to let you continue program execution, toggle the stack trace display, or terminate the application. There's also a button for filtering out specific errors.

SafeWin supports most of the Windows 3.1 API; the exceptions are the Pen,

SeaBreeze Software Systems

SafeWin

BY RICHARD HALE SHAW

SafeWin, Version 2.0, from SeaBreeze Software Systems, is a \$249 diagnostic and analysis tool for Microsoft Windows 3.x developers. Packaged as a Windows DLL, you need only relink your C or C++ program and include SafeWin's import library. After that, SafeWin will sit silently by, intercepting calls to the Windows API, checking the parameters you pass, noting return values, and logging the creation and deletion of Windows objects such as bitmaps and brushes. Of the more

The idea behind SafeWin is simple and elegant. SafeWin notifies you whenever a Windows API function returns an error.

than 700 functions available under Windows 3.1, SafeWin monitors over 500, including the Window Manager functions, most GDI functions, and the System Services.

A QUIET SAFETY NET

The idea behind SafeWin is simple and elegant. SafeWin notifies you whenever your program passes a questionable parameter such as an invalid pointer or handle, or when a Windows API function returns an error. If your program fails to free a global memory block or delete a bitmap before it exits, SafeWin will let you know. And if you're using Windows 3.1, SafeWin can trap more serious er-

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APPLICATIONS DEVELOPMENT

Debugging Tools

Multimedia, and OLE classes (though the product documentation claims support for OLE). It also monitors the Windows 3.1 functions that are found in COMMDLG.DLL and DDEML.DLL, as well as the OLE, TrueType, and Version APIs, but it omits some of the older, less-used functions from Windows 2.x. It also won't monitor communications functions or the Windows 3.1 functions that manipulate the installable device drivers or the Control Panel applets.

AND YOU CAN CUSTOMIZE IT

SafeWin includes a monitor program that lets you customize its DLL at runtime. The monitor lets you specify which types of objects (Device Contexts, Bitmaps, Memory, and so on) are monitored, and whether to monitor creation, deletion, or both. You can also toggle OutputDebugString interceptions, pointer validation, and RIP trapping. You can even have the monitor create a log of every message sent to the application. Plus, SafeWin's monitor can perform heap walks and enumerate modules and tasks—just like tools in the Windows SDK (Software Development Kit). And at any time, you can use the monitor to call up a list of the active objects that belong to your program.

SafeWin includes an API which can provide the same error-trapping services and object information offered by the SafeWin monitor—indeed, it's what the monitor uses. While you'll have to recompile your program to access this API, it goes beyond the monitor's functions by letting your program receive and control the information available to the monitor.

While you can use the SafeWin monitor to redirect SafeWin's output to a file or to a second monitor, this feature does not always work flawlessly. We couldn't get SafeWin to use the second monitor with our standard setup. The folks we spoke with at SeaBreeze indicated that they had heard reports that SafeWin might not work with some video boards

(in particular, Video7 clones), but they didn't say if a fix was in the works.

THE BUTS

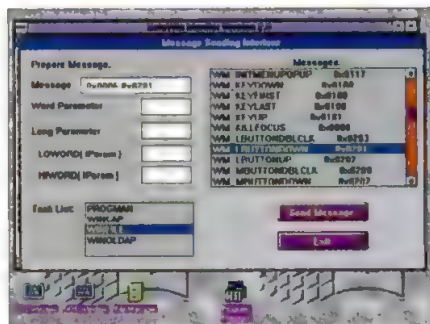
SafeWin does have its limitations: The DLL is not designed to be used by more than one application at a time. If you do

use it with more than one application, SafeWin can't determine which objects belong to which application. While the package does include functions that monitor local heap allocation, you must implement them as macros; also, you will need to re-

compile your program to use them.

Moreover, SafeWin is for Windows programming only; to monitor DOS programs, you'll have to purchase a separate DOS analysis tool. (SeaBreeze's SafeHeap, Version 1.5, is one such tool reviewed in this roundup.) While SafeWin's DLL is language-independent, SeaBreeze does not offer header files or import libraries for use with Microsoft Visual Basic or Borland Pascal.

Despite its limitations, SafeWin is a



SafeWin's Monitor includes a Message Sending dialog that lets you send any Windows message to any app.

FACT FILE

SafeWin, Version 2.0

SeaBreeze Software Systems,
1330 Hwy. 206, Skillman, NJ 08558;
609-924-6793

List price: \$249

Requires: Microsoft Windows 3.x (Windows 3.1 recommended), either Borland C++ 3.x, Microsoft C 6.0, or Microsoft C/C++ 7.0.

In short: SafeWin is a Windows DLL that replaces most of the standard Windows API functions with a replacement set that warns of invalid parameters, failed function calls, and unfreed resources. You need only relink your program with SafeWin and rerun it to generate the report. SafeWin's ease of use and valuable monitoring features make it a highly worthwhile tool for Windows programmers.

ON READER SERVICE CARD

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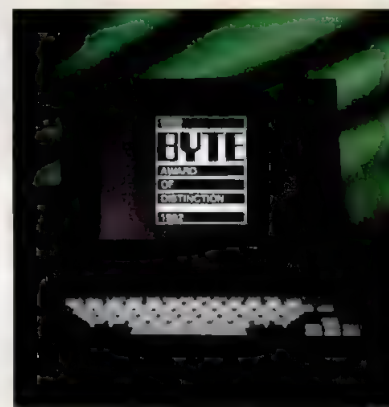
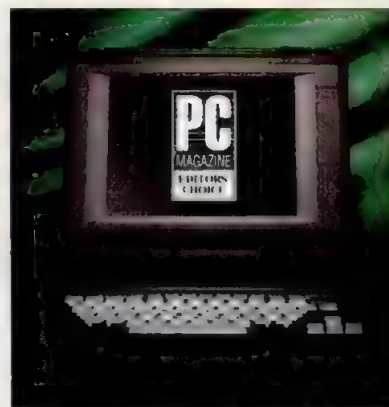
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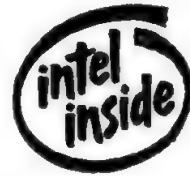
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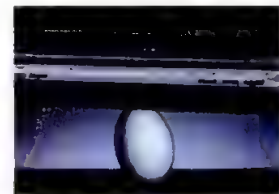
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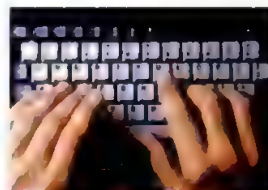
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APPLICATIONS DEVELOPMENT

Debugging Tools

very valuable tool. Running transparently alongside your application, it notifies you when an object isn't deleted or when an API function fails. And if you're in the bad habit of not checking API return values (a practice that's propagated

throughout the SDK sample programs and countless Windows programming texts), that bug won't bite you if you use SafeWin. It's an indispensable tool for Windows developers who program in C or C++.



Syntax Checkers

Gimpel Software

PC-lint 386

BY REX CONN

Gimpel Software's PC-lint 386, Version 5.00 (\$239), is a DOS and OS/2 version of the C syntax checking programs that are popular on the Unix platform. Syntax checkers walk through your code looking for errors in your use of the programming language; in other words, they check to see if you're speaking C correctly. Like the syntax checkers provided with your language's compiler, PC-lint analyzes your source code and produces messages that warn you when you might not be saying what you mean.

But with all the improvements that have been made in the error-checking and reporting functions of the latest C compilers, why do you need a separate program to check C syntax? Because compilers don't look across all source files to see if variable references and function-call parameters match. And compilers will accept without a quibble non-portable syntax, or quirky C code that, although valid, is frequently not what you intended (for example, using `=` instead of `==`, or `!` instead of `!=`).

PICKY, PICKY!

The first time you run PC-lint against a large C program, you'll be appalled at the number of error, warning, and informational messages it generates. The key to

using PC-lint successfully is determining which of these messages is significant and which is simply the result of your coding style or your compiler's features, and then configuring PC-lint accordingly. Because PC-lint is so thorough, you'll want to disable some of its warning and informational messages when debugging all but the most trivial C programs; otherwise, you'll drown in excess detail.

PC-lint is a complex and versatile program with more than a hundred options and several hundred messages. In order to simplify and organize their usage, PC-lint uses "indirection files" (with an .LNT extension) to define the source files and PC-lint options for a project. Although some sample .LNT files are included, you should expect to spend several hours of trial-and-error experimentation config-

PC-lint is a complex and versatile program with more than a hundred options.

uring PC-lint for your environment and programming style. PC-lint uses a utility to read MAKE files and generate the .LNT template. If Gimpel had the utility also ask questions about programming style and

insert the appropriate options into the .LNT file, the initial barrier to using PC-lint would have been eliminated.

FINDING NEEDLES IN A HAYSTACK

PC-lint analyzes each specified source file. If it finds problems, it displays the source-code line, the file name, the line number, and a brief message (error, warning, informational, or elective). After all source files have been processed, its final action is to produce a "Global

SUMMARY OF FEATURES

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Products listed in alphabetical order

■ = YES □ = NO

	SYNTAX CHECKERS		
	Borland C++ 3.1 (with -w option)	Microsoft C++ 7.0 (with -W4 option)	PC-lint 386
List price	\$495	\$499	\$239
Creates executable programs	■	■	□
Unreferenced Value Warnings			
Symbols (such as macro, typedef)	□	□	■
Functions	□	□	■
Global variables	□	□	■
Automatic variables	■	■ (if not initialized)	■
Structure members	□	□	■
Include-File Warnings			
Unused	□	□	■
Repeated	□	□	■
Variable Assignment and Evaluation Warnings			
Using uninitialized variables	■	□	■
Constant out of range (such as char c=300;)	□	■	■
Overflow in computing constant expression	□	□	■
Loss of fraction (such as double x = 10/3;)	□	□	■
Bit-field overflow	□	□	■
Loss of precision (double to integer)	□	■	■
Too few initializers (such as int a[4] = {0, 1, 2;})	□	□	■
Too many initializers	■	■	■
NULL truncated from a string	□	□	■
Relational test of a signed and unsigned value	□	■	■
Unary minus applied to an unsigned value	□	□	■
Local and global variable with same name	□	□	■
Excessive shift value	□	□	■
Ambiguous operator priority	■	□	■
Ambiguous order of evaluation (a[i] = i++;)	□	□	■
Language-Use Warnings			
Assignment (=) versus test (==)	■	□	■
Use of bitwise operators (& or versus && or)	□	□	■
Fall-through to next CASE statement in a "switch" block	□	□	■
Unreachable code (never executed)	■	□	■
If/else statements do not match indentation	□	□	■
No condition in "for" loop	■	□	■
Empty "for" loop	□	□	■
Function Checking			
Function returns undefined value	■	□	■
Function returns wrong type	□	■	■
Function returns address of "auto" variable	□	□	■
printf/scanf family argument checking	□	□	■
Parameter checking of calls to functions in other modules	■ (if prototyped)	■ (if prototyped)	■

Wrapup" section, which reports any cross-module problems and suggests source-code changes. But the Global Wrapup's confusing implementation somewhat diminishes its usefulness. Error messages and suggestions for both code and data are lumped together; sorting and formatting the report would make it much easier to analyze.

The PC-lint user's manual is an extensive (and frequently esoteric) 311 pages. It is written for the experienced developer; novices will find it rather tough sledding. And all users should be prepared to spend a few hours studying the manual and experimenting. If you get stuck, Gimpel's technical support, available by telephone or fax, is excellent.

PC-lint 386 uses the Phar Lap DOS extender and is compatible with native DOS, Windows, and OS/2 2.0 virtual DOS machines. It comes with configuration files for more than 30 C compilers, plus a generic customizable configuration in the unlikely event that your compiler isn't supported. Gimpel is currently developing a C++ version of PC-lint.

Although configuring and learning to use PC-lint can be a struggle, experienced C programmers will find the effort a solid investment. Once configured, PC-lint requires little additional attention, and it will unearth oddities, idiosyncrasies, and bugs in your source code that no other program can find. □

FACT FILE

PC-lint 386, Version 5.00

Gimpel Software, 3207 Hogarth Ln.,
Collegeville, PA 19426; 215-584-4261;
fax, 215-584-4266



List price: \$239

Requires: 386-based PC or better, 512K hard disk space

In short: PC lint is an excellent tool for checking C syntax and analyzing source code. It goes far beyond the syntax checking capabilities of even the best C compilers.

PC lint's major drawback is the lack of a configuration utility—it can take several hours of trial and error to configure PC-lint for a large project. Experienced programmers will find PC lint invaluable; novices will find it bewildering.



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(CIRCLE 055 ON READER SERVICE CARD)

Pulling Numbers Out of Strings

BY NEIL J. RUBENKING

PULLING NUMBERS OUT OF STRINGS

With the FIND command DOS provides limited text-processing capabilities but no straightforward facility for spotting numbers within a string. To deliver some digit-detecting muscle to the command line, I created NUMBER.COM. This utility scans whatever string you pipe to it and, via an exit code, returns either the first number it encounters or an error value. Batch files can test the exit code using the IF ERRORLEVEL command. The string piped to NUMBER may contain any integer from 0 on up, but the program reports 250 for any number greater than 249. Invoked without a string piped to it, the utility pauses for input, processing the input when you press Enter. Attempting to execute NUMBER with a parameter after it causes a usage message—which includes the error codes—to display.

NUMBER accepts two options, but only one at a time; you can't use both together. /S tells the program to skip any initial nonnumeric characters. (NUMBER automatically ignores leading spaces and tabs but, if invoked with no command line switch, it stops processing if the first character it encounters is nonnumeric.) Input such as abc 123 returns an exit code of 123 with /S, but 254 (no number found) without it.

The other option, /+n (where n is any integer up to the command line limit of 127), causes NUMBER to start processing from the nth character of the input string. /+6 with an input of 12 34 56, for example, returns an exit code of 56.

If the utility encounters a problem, it sets ERRORLEVEL as follows:

```
252 no text entered
253 offset too big
254 no number found
255 invalid option
```

NUMBER is most useful as a filter (that is, accepting the output of some other command as its input). To give a

simple example, the command ECHO 10 | NUMBER returns an exit code of 10. Use an IF ERRORLEVEL statement after a line similar to the above and you can see if an environment variable or (as shown below) a command line parameter is an integer greater than, say, 99:

```
ECHO %1 | NUMBER
IF ERRORLEVEL 100 GOTO BadNumber
```

NUMBER and FIND provide an even more useful combination. For instance,

```
DIR | FIND "file(s)" | NUMBER
```

sets the exit code equal to the number of files in the current directory.

Occasionally I need a batch file to perform an action, but only if some text string exists in the output of a particular command. The standard User-to-User technique consists of piping the command through FIND and redirecting the output to one temporary file, which you then attempt to copy to another. Since COPY won't work on an empty file, the second file will exist only if the text was found. Here's an example from the May 12, 1992, User-to-User column:

```
SET | FIND "windir=" > TEMP0001.$$$
COPY TEMP0001.$$$ TEMP0002.$$$ > NUL
IF EXIST TEMP0002.$$$ GOTO YesWindow
```

I wanted a simpler test, though—specifically, I hoped to make FIND return information in the ERRORLEVEL. NUMBER, together with FIND's /C switch,

does exactly that. SET | FIND "text" lists all lines in the environment containing the word *text*, for example, and FIND /C "text" returns the number of lines containing that word. With this in mind, the above example could be rewritten using NUMBER, as

```
SET | FIND /C "windir=" | NUMBER
IF ERRORLEVEL 1 GOTO YesWindow
```

I tried to make NUMBER.COM as short as I could, but it seems to be longer than typical submissions. I think it makes a fairly useful utility, though.

Darryl K. Nester
Indianapolis, Indiana

► **PC MAGAZINE:** The source code to NUMBER.COM is too long to print here, but you can download it and the other files mentioned in this column from PC Magnet, archived as NUMBER.ZIP. I was able, though, to come up with a relatively short replacement that performs most of NUMBER.COM's functions. Figure 1 shows the DEBUG script SETEXIT.SCR, which creates SETEXIT.COM, a simplified version of NUMBER.COM. Enter the command DEBUG < SETEXIT.SCR > SETEXIT.LOG, then scan the LOG file for the string ^ Error. If it doesn't appear, DEBUG successfully assembled SETEXIT.COM. Otherwise, correct any errors and try again.

SETEXIT does no special error reporting; it simply returns, via its exit code, either the first number in its input, a 0 if none exists, or 255 if the number is greater than 254. SETEXIT acts like NUMBER.COM with the /S switch—skipping all nonnumeric characters—but it has no equivalent to /+n. Even with this limitation, SETEXIT has many uses. A few examples follow. In all cases, SETEXIT can be replaced by NUMBER/S.

- VER | SETEXIT sets the exit code to the major version number.
- DIR FILENAME.EXT | FIND

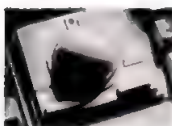
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SETEXIT.SCR

Complete Listing

```

N SETEXIT.COM
A 100
MOV AH,3F ; read from file or device
MOV BX,0 ; 0 is handle of StdIn
MOV CX,80 ; read up to 80h bytes
MOV DX,80 ; address of buffer (use command tail!)
INT 21 ; call DOS function
MOV CX,AX ; get count into CX
JCXZ 13A ; none? Get out!
MOV SI,80 ; SI points to first char of parameter
SUB DI,DI ; using DI as flag
; loop start
LODSB ; load a char into AL
SUB AL,30 ; convert char to number
JL #133 ; less than 9? skip it
CMP AL,9 ; compare with 9
JA #133 ; greater? skip it
INC DI ; DI is non-zero once we have a digit
XCHG BX,AX ; swap BX and AX
MOV DX,0A ; put 10 (decimal) in DX
MUL DL ; multiply AL by 10
JC 12D ; get out if overflow
XCHG BX,AX ; swap BX and AX
ADD BL,AL ; add to BL
JNC 131 ; continue if no overflow
MOV BL,FF ; signal overflow
JMP 13A ; get out
LOOP #116 ; if CX > 0, jump back to loop start
CMP DI,0 ; if DI is non-zero, end it all!
JNZ 13A ;
LOOP #116 ; if CX > 0, jump back to loop start
XCHG BL,AL ; put total in AL
MOV AH,4C ; select terminate w/ exit code function
INT 21 ; call interrupt 21h

RCX
40
W
Q

```

Figure 1: The utility produced by this script sets its exit code to the first number it receives as input.

"FILENAME" | SETEXIT sets the exit code to the size of the specified file or to 255 if the file is larger than 254 bytes.

• ECHO. | DATE | SETEXIT sets the exit code to the current month. (Note that in DOS versions before 5.0, including a space after ECHO. causes the command to fail. For these versions use ECHO. | DATE | SETEXIT.)

• ECHO. | TIME | SETEXIT sets the exit code to the current hour.

• TYPE FILENAME.EXT | FIND /V/C "" | SETEXIT sets the exit code to the number of lines in the specified file.

• DEBUG < FILENAME.SCR | FIND /C "^ Error" | SETEXIT sets the exit code to the number of errors in the DEBUG script FILENAME.SCR.

By using NUMBER.COM with its /+n switch, you can pick any number on the input line, not just the first. The next set of examples will work only with NUMBER.COM, not SETEXIT.COM.

• ECHO. | DATE | NUMBER /+24 sets the exit code to the current day of the month.

• DIR FILENAME.EXT | FIND "FILENAME" | NUMBER /+30 sets the exit code to the year portion of the file's date/time stamp.

• CHKDSK | FIND "directories" | NUMBER /+20 sets the exit code to the number of subdirectories on the current drive.

• VER | FIND "Version" | NUMBER /+18 sets the exit code to minor version number; for example, 30 for DOS 3.30.

As you can see, the NUMBER utility has many applications. Still, the simpler SETEXIT can accomplish many of the same tasks. □

Share your latest DOS and system discoveries through User-to-User. See the "How to Contact Us" sidebar in the Solutions column.

See the Disk Spin.

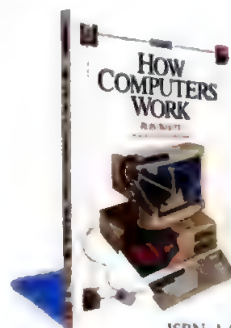


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A Day in the Life Of a Window

BY JEFF PROSISE

To the end user, Windows programs are simplicity itself.

To the programmer, Windows presents a vastly different appearance. Internally, Windows programs have very little in common with DOS programs.

Windows programs embrace a fundamentally different paradigm—an event-driven paradigm—that pervades every fiber of a program's being. In this installment of Tutor, we'll explore the event-driven paradigm that is so fundamental to the Windows environment by taking an in-depth look at the life cycle of a typical Windows program: how it started, how it behaves, and how it terminates.

One concept to grasp right at the start is that in Windows, nearly everything you see on the screen is a window. Push buttons are windows. So are list boxes and dialog boxes and icons. Even the desktop (the background behind all the other windows) is a window in its own right. The life cycle we'll be examining is that of a top-level window—the main window that Windows users often think of as the program itself.

IN THE BEGINNING The first step in running a Windows program is to load it into memory from the .EXE file from disk. In addition to the code and data that make up the program, most Windows .EXE files contain *resources*. Resources are data objects such as bitmaps, menus, icons, cursor images, and dialog box templates. They are embedded in .EXE files with the aid of a programming tool called a *resource compiler*.

Unlike DOS, which typically copies a program to memory in its entirety, Windows usually loads only part of a program; the resources are loaded into mem-

ory if and when they are needed.

If a program is divided into two or more code segments, Windows may initially load only selected segments and then load others as needed. If memory is in short supply, Windows can load new code segments in place of the old ones and then reload the ones that were displaced when they are needed again. This allows large programs to run in small memory spaces.

In his book *Programming Windows*, Charles Petzold notes that the Windows 3.0 version of Write contains 160K of code spread out among 78 separate code segments. The largest segment is only 8K in length, enabling Write to run in as little as 8K of RAM. When additional code segments are needed, Windows loads them automatically. The Windows 3.1 version of Write contains more than 200K of code in 83 segments, the largest of which is about 9K in length. Eighteen of the code segments are marked with a preload flag, which means Windows attempts to load them when the program is started. The remaining 65 are only loaded when needed. All this is transparent to the user, who is typically unaware of the behind-the-scenes machinations Windows employs to make efficient use of memory. Once the program is loaded, Windows transfers control to it.

Every Windows program contains a minimum of two functions (a function in C is similar to a subroutine in other languages). The first one, WinMain, gains control when the program is started. It is WinMain's responsibility to create the window or windows that an application will use and to create a message loop. The message loop is extremely important because it enables Windows programs to check for messages directed to them and then do what the message tells them to do. The second function, which we'll re-

fer to as the *window procedure*, receives and acts upon these messages.

From a conceptual standpoint, the greatest difference between DOS and Windows is that Windows programs do very little of their own work. Instead of taking control of the system and painting screens, checking for keyboard input, and performing other routine application-oriented tasks, a Windows program sits back in a message loop and does only what Windows tells it to do. At various times, Windows may send a program a message telling it that its window needs repainting, or that the user pressed a key. This is why we say that Windows is a message-based or *event-driven* environment. We'll further discuss Windows' message-based architecture in a moment.

THE WINMAIN FUNCTION Windows doesn't create a window for an application by default. Rather, it is up to the program to create the window (or windows) that will represent it on the screen. This happens inside WinMain.

Creating a window is a two-step procedure. First, WinMain registers a window class. The class defines important attributes of the window, such as the address of the function that will process Windows messages (the window procedure), the icon that is displayed when windows based upon this class are minimized, the appearance of the mouse cursor when it is positioned inside the window's borders, and the window's default background color. In Windows, every window is based upon a class. Windows provides several predefined window classes such as buttons and list boxes that applications may use. For their main windows, most applications register a new window class. If another instance of the same program is already running, the Windows program detects this and bypasses the window class registration. There is no need to reg-

ister the window class twice.

Once the window class is registered, one call to a Windows API function creates the window. The function used is usually `CreateWindow` or `CreateWindowEx`; the latter is an extended version of `CreateWindow` that supports a handful of additional window styles. The parameters passed to the function include, among other things, the name of the class upon which the window will be based (the class registered in step 1), the text that will appear in the window's title bar, the window's initial size and position, and a series of flags that define the window style. The window style specifies some of the window's basic characteristics, such as whether it includes minimize and maximize boxes and whether it has a system menu in the upper-left corner.

When the call to `CreateWindow` or `CreateWindowEx` returns, the program is completely loaded and ready to read and process Windows messages. But you may not be able to see it yet. Unless the window style included a `WS_VISIBLE` flag, the window remains hidden until the program tells Windows to display it. This is accomplished easily enough with a call to the Windows API function `ShowWindow`, usually followed by a call to `UpdateWindow` to send the window a `WM_PAINT` message, which tells the window procedure to paint the window's interior.

The final task required of the `WinMain` function is to create the message loop that the program will use. To the programmer, it looks something like the following:

```
while (GetMessage (&msg,
    NULL, 0, 0) != 0) {
    TranslateMessage (&msg);
    DispatchMessage (&msg);
}
```

Each time an event such as the press of a key or the click of a mouse occurs, Windows formulates a message that describes the event and places it in the system message queue. Then Windows determines which program should be notified that the event occurred and places the message in that program's queue.

The program retrieves the message with `GetMessage`. Then it calls `Trans-`

`lateMessage`, which converts keyboard messages (for example, a `WM_KEYDOWN` message containing a virtual key code) into easier-to-understand character messages (for example, a `WM_CHAR` message saying the "A" key was pressed). This process is illustrated schematically in Figure 1.

If the program owns more than one window, as most Windows programs do, `DispatchMessage` makes sure that the message is sent to the correct window procedure. After the message is dispatched, the *while* loop executes again and the next message is retrieved from the queue and dispatched. The program continues to loop in this manner until `GetMessage` returns 0, which only happens when a special message—`WM_QUIT`—is retrieved from the message queue. Once the loop is exited, `WinMain` terminates, which also causes the application to terminate.

It is through the `GetMessage` function that Windows implements a nonpreemptive form of multitasking. If `GetMessage` is called and there are no messages waiting in the application's message queue, Windows will yield control to other Windows programs. Control is passed around in an organized fashion that ensures every active program gets a share of the CPU. The chief disadvantage to this form of multitasking is that if a program doesn't call `GetMessage` often enough (for example, if it takes several seconds to process a single message), other Windows programs get a lesser share of the CPU.

MESSAGES By now you've gotten the picture: Just about everything that happens in a Windows program happens as the result of a message. In all, Windows defines

more than 200 messages that window procedures may send or receive, and additional messages may be defined for special use on a per-application basis. Figure 2 lists 20 of the most-often-used messages. The `WM_` prefix preceding each message name means "Window Message." There are other prefixes corresponding to other message classes, but `WM` messages are the most common.

In the course of its lifetime, a window may receive hundreds of messages. Some come only once. When a window is created, for example, its window procedure receives a `WM_CREATE` message. In effect, `WM_CREATE` is like a signal from Windows that says, "Okay, I'm about to create the window. Do what you need to do to prepare for it, and then return control to me." This is a great time to perform routine initializations such as allocating memory for data storage or creating GDI (Graphics Device Interface) objects (such as brushes, pens, and fonts) that will be used later.

Other messages occur repeatedly. When you drag the mouse pointer across a window, the window procedure receives a flurry of `WM_MOUSEMOVE`

The Windows Message Loop



Figure 1: When an event such as a keystroke or mouse click occurs, Windows formulates a message that describes the event and places it in an area called the system message queue. The application's `WinMain` function retrieves the message from the queue and dispatches it to the appropriate window procedure, where the message is processed. The message loop repeats, alternately retrieving and dispatching messages, until the application receives a `WM_QUIT` message signaling it to terminate.

messages. When you move a window and doing so uncovers another window, the latter window's window procedure receives a WM_PAINT message and responds by repainting the part of the window that was uncovered. When you click the left mouse button over a push button, the push button, which is a window itself, processes the mouse messages it received from Windows and in turn sends a message to the main window notifying it that the push button was clicked.

These are just a few examples. There are "spy" programs available for Windows that display all the messages flying around in the system. Most users are shocked to see the volume of message traffic the first time they run a spy program. At times, the messages literally come faster than you can count them. The majority of messages a program receives are ignored and are passed to an API function called DefWindowProc, which provides default responses for all messages. That's the beauty of it. When you write a Windows app, you need only concern yourself with the messages that are of consequence to your program. Everything else is handled by Windows.

Window procedures sometimes *send* messages, too. For example, if a window procedure wants to find out what was typed into an edit control (an edit control is actually a window itself, based on Windows' predefined EDIT class), it sends the edit control a WM_GETTEXT message. The control's window procedure, which is part of Windows, in turn copies the text into a buffer whose address was passed along with the message.

An important point to understand in the midst of all this is that Windows supports all the basic functionality of a window (via DefWindowProc) with no effort required on the part of the program that owns the window. For example, a window procedure needn't trap mouse messages to allow the user to resize a window. Windows takes care of that itself. Windows also displays pull-down menus when the user clicks the left mouse button with the cursor over a menu bar, iconizes a window when the minimize button is clicked, zooms a window to full-screen when the maximize button is clicked, and much more. In fact, it's possible to write a do-nothing Windows program that doesn't

A Sampler of Windows Messages	
Message	Received when. . .
WM_ACTIVATE	The window is activated or deactivated
WM_CHAR	A character key is pressed or released
WM_CLOSE	The user has requested that the application terminate
WM_COMMAND	A menu item is selected, a control window has a message to send to its parent, or an accelerator keystroke is translated
WM_CREATE	The window is created
WM_DESTROY	The window is about to be destroyed
WM_HSCROLL	A horizontal scroll bar is clicked
WM_INITMENU	A menu is about to be displayed
WM_LBUTTONDOWNCLK	The left mouse button is double-clicked
WM_LBUTTONDOWN	The left mouse button is pressed
WM_LBUTTONUP	The left mouse button is released
WM_MOUSEMOVE	The mouse is moved
WM_MOVE	The window is moved
WM_PAINT	The window needs to be repainted
WM_QUIT	The application is about to be terminated
WM_RBUTTONDOWNCLK	The right mouse button is double-clicked
WM_RBUTTONDOWN	The right mouse button is pressed
WM_RBUTTONUP	The right mouse button is released
WM_SIZE	The window is resized
WM_VSCROLL	A vertical scroll bar is clicked

Figure 2: Messages are the foundation upon which Windows programs are built. Listed here are 20 of the most common messages received by window procedures.

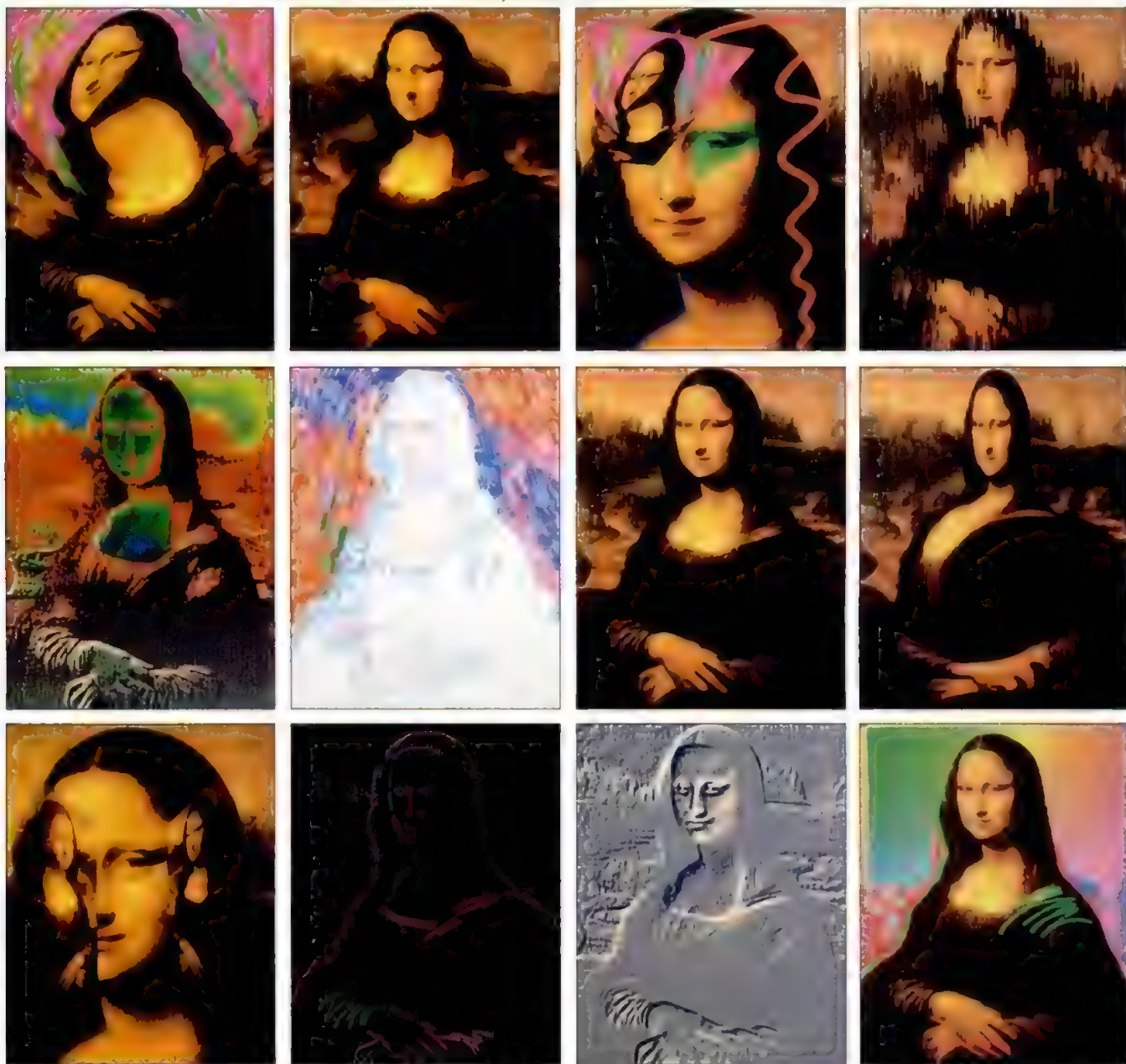
process a single message and yet still acts in virtually every way like a "normal" window. You can move it, resize it, do just about anything you want with it, and it's Windows that bears the burden of making sure it all happens.

TERMINATION When you terminate a Windows application by selecting Close from the system menu, the program's window procedure receives a series of messages. Two of these messages are WM_CLOSE and WM_DESTROY. WM_CLOSE is received first; it notifies the window procedure that the user wishes to terminate the application. A window procedure's usual reaction to this message is to call the API function DestroyWindow to close the window and any child windows associated with it. However, the window procedure may ask "Are you sure?" or "Save changes before exiting?" A window can reject the WM_CLOSE message by telling Windows it handled the message (by returning 0) but *not* calling DestroyWindow.

Calling DestroyWindow places a WM_DESTROY message in the window's message queue. When the message is received, the window has already ceased to exist and is no longer displayed

on the screen. It's too late to "save" the window. However, it's a great time to free memory blocks and system resources such as menus or GDI objects that were allocated at the beginning of the program. An important distinction to make here is that even though the window no longer exists, the program does. The message loop in WinMain is still running—still processing messages. To terminate the application, the window procedure typically calls the API function PostQuitMessage during processing of the WM_DESTROY message. PostQuitMessage places a WM_QUIT message in the application's message queue, causing the message loop in WinMain to stop repeating and to terminate the program.

FURTHER READING If you're interested in learning more about Windows programs, and the internals of Windows itself, let me suggest Jeffrey Richter's excellent book, *Windows 3.1: A Developer's Guide* (1992, M&T Publishing). Chapter 1, "Anatomy of a Window," gives an up-close account of what windows are and how Windows manages them internally. The rest of the book contains useful discussions of programming topics and is loaded with source code examples. □



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Demystifying CONFIG.SYS

In OS/2 2.0, Part 2

BY JOE SALEMI

In the previous issue, we looked at three of the six categories of commands you can use in your OS/2 CONFIG.SYS file to optimize system performance. These were Operating System Commands, Optional Devices, and Memory Management. Here in Part 2, we'll consider the remaining groups: Performance, Application Configuration, and User Preferences.

PERFORMANCE These parameters affect the speed of OS/2 operations either directly, or indirectly through the way the operating system interacts with such hardware subsystems as the hard disk or printer. BUFFERS, CACHE, DISKCACHE, FILES, and PRINTMONBUFSIZE also have an effect on system memory management: The higher the value you set for each parameter, the more memory it uses. Conversely, lower values free up RAM for your applications to use. In discussing these parameters, I'll suggest the values I've found to provide the most performance for the least memory expenditure.

BUFFERS= This command sets the number of 512-byte disk buffers that the system can use for direct disk writes. Unlike the other statements that control disk caching, BUFFERS primarily affects direct I/O writes to FAT disk partitions. These direct writes are controlled by the IOPL command, which was covered in Part 1.

At installation, OS/2 sets this parameter to 30. You can save some memory by setting BUFFERS=10 without adversely affecting performance, according to the authors of the "OS/2 2.0 Installation and Performance Considerations" article mentioned in Part 1. If you have an all-HPFS system, you can reduce this setting to 3. Don't omit the command or set it lower than 3, however, or OS/2 will de-

fault to the initial value of 30.

CACHE.EXE This OS/2 utility starts and controls the HPFS disk cache. The size of the cache is established on the IFS= command line that loads the HPFS drivers. Although not precisely a CONFIG.SYS command, CACHE.EXE can be loaded by CONFIG.SYS using the RUN= command. (RUN will be covered fully in the section on user preferences below.) As an alternative, you can also load CACHE.EXE from the STARTUP.CMD. The installation process puts

*In this second of
two parts, we complete
our discussion of how
to use the OS/2
CONFIG.SYS file to
achieve maximum efficiency.*

it in the CONFIG.SYS file, however, and it should be left there. The line in CONFIG.SYS looks something like this:

```
RUN=C:\OS2\CACHE.EXE
```

The HPFS disk cache supports what are called *lazy writes*. The name derives from the fact that the operating system delays writing changed data to disk rather than write it immediately. Lazy writes increase performance, but at the risk of losing data if the system should crash before all the changes are permanently saved. CACHE defaults to having the lazy writes option turned on. If you prefer to turn the option off, you must create a STARTUP.CMD file and put the following line in it:

```
C:\OS2\CACHE.EXE /LAZY:OFF
```

You can enter the above line at an OS/2 command prompt at any time to turn lazy writes off. If you want to suspend lazy writes only temporarily, you can turn them back on again by entering the following at a command prompt:

```
DETACH C:\OS2\CACHE.EXE /LAZY:ON
```

(DETACH is an OS/2 command that tells the operating system to run the application in the background. It can be used only with applications that don't require user input while running.)

It's important to note that if you have lazy writes active you must run the Shutdown option from the WorkPlace Shell menu before turning your system off or rebooting it. This ensures that any data left in the cache will be written to the disk. Failure to shut the system down properly can cause data loss.

Three CACHE parameters control the lazy writing process (you can put one or more of these parameters on the command line when you load CACHE.EXE using RUN, and you can change them at any time by running CACHE at a command prompt):

- **/BUFFERIDLE:** This parameter sets the number of milliseconds that the cache buffer must be idle before the cache writes updated data to the disk. The default is 500 milliseconds (.5 seconds).

Changing this default can have an adverse effect on system performance. If you decrease the setting, the cache might start writing to the disk before the application finishes making any necessary changes to its cached data. This would then would force the cache to make a second disk write to incorporate the updated data. Indeed, a decreased BUFFERIDLE setting generally produces more

frequent disk writes, which slow the system down. On the other hand, increasing the idle time could result in data loss, particularly if the operating system crashes before the disk has been updated. My recommendation is to leave **BUFFERIDLE** at its default setting.

- **/DISKIDLE**: This parameter specifies how long the disk itself must be idle before the cache writes out changed data. The default is 1,000 milliseconds (1 second), which IBM recommends as representing the best balance between system performance and the risk of data loss in a system crash.
- **/MAXAGE**: This parameter sets the amount of time (in milliseconds) that the cache waits before reorganizing the cached data or writing it to disk. For read-only data, **MAXAGE** controls the time **CACHE** waits before moving data that has not been accessed recently to the back of the cache and moving more frequently used data to the front.

If the data in the cache changes, **MAXAGE** controls the maximum amount of time the system can wait (that is, laze about) before writing the data to disk. Naturally, this applies only if you have lazy writes active. If you've set **LAZY=OFF**, the **MAXAGE** parameter has no effect on how long the cache waits to write updates to the disk.

The default **MAXAGE** setting is 5000 milliseconds (5 seconds), which I think is too long to wait. I recommend you decrease this setting to reduce the chances of data loss in the event of a system crash, especially if you're storing critical data or running a database that's constantly being updated. Like the **BUFFERIDLE** parameter discussed above, however, a setting of less than 500 milliseconds (.5 second) can adversely affect system performance. Depending on the number of updates you make to data on the disk, the best setting for preserving data integrity is between 500 and 2000.

The best way to find the right setting for your system is to start with **MAXAGE** set to 500 and increase the setting by 250 at a time until you find the proper number for your situation. If one of your primary applications is a disk-intensive database, for example, you'll probably end up with a setting of 1000 or lower. You'll know you've hit the proper bal-

ance between guarding against data loss and maintaining system performance when there are no noticeable pauses in the foreground application caused by frequent writing to the disk. You can inspect the current cache settings by running **CACHE** without any parameters at any command prompt.

DISKCACHE= This **CONFIG.SYS** command sets the size and parameters for the FAT disk cache; it has no effect on HPFS partitions. The first parameter on the **DISKCACHE** command line must be the size of the cache, in kilobytes. Recommended sizes for various amounts of system RAM and file system mixtures were covered in Part 1. Following the cache size, you can add three other parameters (separated by commas, as usual) on the command line:

- **LW** Adding this parameter turns on lazy writes for the FAT drives. The default is **OFF**. Although lazy writes for the HPFS cache can be turned off on the fly, to turn off lazy writes for the FAT cache you must delete the **LW** parameter from **CONFIG.SYS** and reboot the system. All the cautions about performing a proper system shutdown discussed above in connection with **CACHE** also apply here.
- **T** The **T** parameter is actually a second number. It sets a threshold for the number of 512-byte sectors the cache will read from the disk at one time. The default is 4 if this parameter is omitted. IBM recommends setting it to $\frac{1}{4}$ the size of the disk cache. For caches of 256K and higher, this would mean a setting of 128 sectors (that is, 64K), which is the maximum allowable. The **T** setting doesn't increase the amount of memory used by the cache, but it can have a significant impact on hard disk performance.
- **AC:ddd** This parameter is equivalent to the **AUTOCHECK** parameter for the HPFS device driver. It tells the system to automatically run **CHKDSK /F** on the drive(s) specified when the system boots. This is particularly handy for checking the drive on which you have installed the main OS/2 files. OS/2 keeps some of the system files open the entire time it's operating, which prevents you from running **CHKDSK /F** on that drive. Thus, putting this command in **CONFIG.SYS** ensures that the disk is checked for errors or problems each time you start OS/2.

The following example shows a **DISK-CACHE** line for a system with 8MB RAM and a mixture of FAT and HPFS drives. It sets the cache to 256K, turns on lazy writes, sets the threshold to 128 sectors (64K), and runs **CHKDSK /F** on the C: drive when the system boots:

```
DISKCACHE=256,LW,128,AC:C
```

FILES= This command is identical to its DOS counterpart. It sets the maximum number of open files for an individual DOS or Windows session and has no effect on OS/2 sessions. The minimum is 20 (which is also the default), and the maximum is 255. Increasing **FILES** to 50 provides more than enough file handles for the majority of DOS or Windows applications. Note that many DOS applications are *self-limited* to using only 20 open files; no fiddling with OS/2 parameters can change that.

MAXWAIT= OS/2 is a preemptive operating system, which means that the system has complete control over the amount of time different applications can run before giving up the CPU to another application. **MAXWAIT=** sets the maximum number of seconds that a low-priority background task can stay idle. If this maximum time elapses, OS/2 increases the task's priority level to ensure that it gets a chance to run. The default is 3 seconds, which establishes a reasonable balance between smooth performance of the foreground application and continued processing of background applications. According to IBM, there's no reason to change it.

PRINTMONBUFSIZE=a,b,c This command sets the size, in bytes, of OS/2's LPT1, LPT2, and LPT3 print buffers, respectively. If this command is omitted from **CONFIG.SYS**, the default (also the minimum) is 134 bytes per printer port. The maximum is 2,048 bytes. You must specify values for all three ports even if you're only changing one of them. Thus, if you want to increase the size of the print buffer on LPT2 to 512 bytes, you should add this line to **CONFIG.SYS**:

```
PRINTMONBUFSIZE=134,512,134
```

According to IBM's recommendations, you should change the buffer size



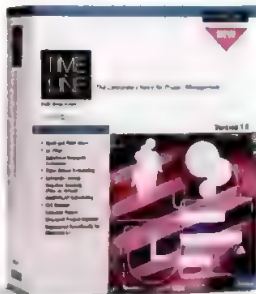
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to either 256 or 512, depending on the speed of your printer; slower printers should have larger buffers.

PRIORITY= This is another parameter that controls OS/2's preemptiveness. The default is DYNAMIC, which lets OS/2 change the priority of different tasks to ensure that they all share the CPU's time. If you're running an application that depends on critical timing, such as one that gathers real-time data, you should change this setting to ABSOLUTE, which will prevent the operating system from changing the priority level of a task to ensure it gets a chance to run. If one application has a much higher priority level than all other tasks, the ABSOLUTE setting gives that application, not the operating system, complete control over when to release the CPU. For all but critical timing situations, leave the PRIORITY setting at DYNAMIC.

PRIORITY_DISK_IO= This parameter controls which applications have priority access to the hard disk. The default setting is YES, which gives the foreground application primary access to the disk, at the expense of background applications. If you usually run disk-intensive applications in the background (for example, database sorts or large file downloads), set this to NO. NO gives all applications equal access to the disk.

TIMESLICE= The final preemptive control parameter is TIMESLICE=. It controls the minimum and maximum amounts of time an execution thread can be active before it gives up the CPU to another thread. TIMESLICE= can take either one or two values. If two values (separated by a comma) are present, the first sets the minimum number of milliseconds a thread gets, and the second sets the maximum amount of time. The bare minimum is 32 ms, and the maximum is 65,536 ms. The only rule is that the maximum setting must be equal to or higher than the minimum. If only a single value is present, OS/2 uses that value for both the minimum and the maximum.

The TIMESLICE= parameter is usually omitted from CONFIG.SYS when OS/2 is first installed, so the operating system uses its default value of 32 ms for both values. At the default TIMESLICE= settings, if you usually run more applications than you have RAM for,

your system will waste a lot of processor time paging data to the disk. Studies by IBM and others have shown that the best values under such circumstances are 64 and 128. These increase the time a task runs before the operating system pages the memory contents to disk, and can be implemented by adding the following line to your CONFIG.SYS file:

```
TIMESLICE=64,128
```

APPLICATION CONFIGURATION Like DOS, OS/2 can use environment variables to configure OS/2 applications. OS/2 environment variables also use the

```
SET varname=command
```

format to put the value of the variable into the environment space. Note that SET commands in the OS/2 CONFIG.SYS apply only to the operating system and OS/2 applications. The PATH command for DOS and for Windows applications running in OS/2 is established in the OS/2 version of AUTOEXEC.BAT. The five environment variables OS/2 uses to control the overall operation of system utilities and OS/2 applications are BOOKSHELF, DPATH, GLOSSARY, HELP, and PATH.

- **SET BOOKSHELF=** The BOOKSHELF variable tells OS/2 where to find the .INF files that contain the on-line reference manuals. OS/2 ships with two manuals: a command reference and a reference for the REXX extended batch programming language. The default setting puts the \OS2\BOOK subdirectory on the system boot drive. You can free up disk space by moving these files to another partition and changing SET BOOKSHELF= to point to the new location. If you have an HPFS partition, for example, you should move the reference manual files there to speed up searches.

- **SET DPATH=** DPATH stands for data path; OS/2 applications can use this environment variable to find data and configuration files that aren't in the current directory. When you first install OS/2, DPATH is set to the directories in which the operating system data files are stored. End-user applications, when installed, will usually add their own data paths to the end of the DPATH. If not, the appli-

cation manual may tell you to edit this command and add the data path yourself. Either way, make sure that the new information goes *after* the default data paths that OS/2 sets. That will ensure that the operating system can find its own data files quickly.

- **SET GLOSSARY=** The GLOSSARY variable tells OS/2 where to find the data files for the glossary portion of the on-line documentation. The default setting is the \OS2\HELP\GLOSS subdirectory on the system boot drive, but, as before, you can free up disk space by moving these files to another partition. You can also move the glossary files to an HPFS partition to speed up searches.

- **SET HELP=** This variable tells OS/2 where to find its on-line help files. OS/2 applications can also use the directory to which this variable points to store their own help files. The default location is the \OS2\HELP subdirectory on the system boot drive; again, you can move these files to another drive or to an HPFS partition to speed up searches.

- **SET PATH=** This command is identical to the PATH command in DOS: It tells the operating system where to find executable programs and batch files that are not in the current directory. Note, however, that the CONFIG.SYS PATH command applies only to OS/2 sessions. You must set the PATH for DOS and Windows applications in the OS/2 version of AUTOEXEC.BAT.

USER PREFERENCES The remaining CONFIG.SYS commands and parameters are used to configure the operating system to your liking. Some of them are established when you install OS/2 and usually don't have to be changed. You can add or change the rest to customize the system to your working style.

AUTOFAIL= This command tells OS/2 what action to take when an error occurs; for example, when a disk is not ready or a file is not found. The default action parameter, NO, pops up a dialog box with an error message and presents you with a choice of actions to take. Changing AUTOFAIL to YES causes OS/2 to simply display an error number and return the error code to the application that caused the error, precluding user intervention. You'll want to leave this set to NO so you get complete in-

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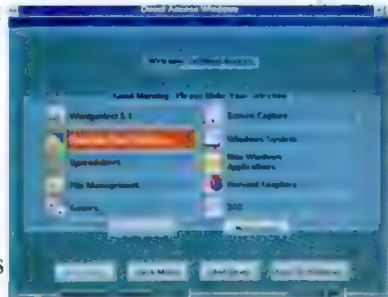
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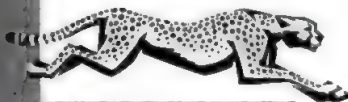
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formation on system problems.

BREAK= This command affects only DOS and Windows sessions. It determines how often an application checks for the CTRL-C key combination. The default value is OFF, which tells the applications to check for CTRL-C only during standard input or output, printer output, or auxiliary output. This setting provides the best performance. Setting **BREAK** to ON lets you break the operation of the program at any time. This forces the program to check the keyboard buffer for the CTRL-C keystrokes constantly. Since this obviously will have a negative effect on the performance of DOS and Windows applications, you should leave the setting at OFF.

CODEPAGE= Code pages are IBM's name for the customized character sets that establish the keyboard and display characters for various native languages. Code pages are identified by number. In the US, **CODEPAGE** defaults to the 437 and 850 code pages; 437 is English, and 850 is a default multilingual character set. The **CONFIG.SYS** line looks like this:

```
CODEPAGE=437,850
```

The first number is the initial code page used. You can switch between code pages by using the **CHCP page#** command at any system prompt. Other code pages shipped with the operating system support Japanese, Canadian French, Hebrew, Chinese, and other languages. Although you could change the **CODEPAGE=** value manually, since other settings depend on it, it's better to use the Country and Selective Install programs found in the System Setup folder.

COUNTRY= This command sets the default values for such country-specific parameters as the common formats for date, time, and currency. It's somewhat like the International Dialing Access code used to make long-distance calls to a particular country. The command takes two parameters. The first is a three-digit number that tells OS/2 which country's defaults to use. For the U.S., this first parameter is 001; for Great Britain, it's 011. The second parameter is the location of the file that contains the various settings. This defaults to `\OS2\SYSTEM\COUNTRY.SYS` on the system boot drive. Un-

less you have a custom **COUNTRY** file, there's no need to change this setting.

In the U.S., the line in question reads:

```
COUNTRY=001,C:\OS2\SYSTEM
\COUNTRY.SYS
```

Again, it's best to make any changes to this line with the Country setup program in the System folder.

DEVINFO= **DEVINFO** stands for device information. The command works with **CODEPAGE** to set up the character sets for different system devices: the screen, the keyboard, and the printers. Each device has its own **DEVINFO=** line, and the first parameter on the command line determines which device is to be affected. Screen controls are set by **SCR**, the keyboard by **KBD**, and the printers by **LPT#**, where # is printer port number 1, 2, or 3.

DEVINFO= statements for the screen and keyboard must be present; printer controls are optional and are usually installed by print drivers that require them. The second parameter establishes the default setting for a device, and the third is the name of the file that contains the different settings. In the U.S., these two lines are placed in **CONFIG.SYS** when OS/2 is installed on a VGA system:

```
DEVINFO=SCR,VGA,C:\OS2\VIOTBL.DCP
DEVINFO=KBD,US,C:\OS2\KEYBOARD.DCP
```

You can use the Selective Install utility in the System Setup folder to change these values as necessary.

SET varname= A number of environment variables are used to customize the system for user preferences. **SET VIDEO_DEVICES=** and **SET VIO_VGA=** tell OS/2 what type of screen display you have. These are set during the installation process. If you change video cards, you can change these settings with the Selective Install utility in the System Setup folder. Otherwise, leave them at their initial values.

There are three **SET** commands that customize other system functions and that you might want to add to your **CONFIG.SYS**:

- **SET DELDIR=** This turns on OS/2's undelete protection so you can recover any accidentally deleted files. The com-

mand works hand in hand with the included **UNDELETE.COM** utility. The two parameters for this command are the directory used to store the deleted files, followed by the maximum amount, in kilobytes, to be stored. The undelete directory and the files in it have the "hidden" attribute set, so you normally won't see them when you do a **DIR** on the drive.

As an example, if you want to turn on deletion protection for your C: and D: drives and to save a maximum of 512K of deleted files on each, you would add the following line to your **CONFIG.SYS**:

```
SET DELDIR=C:\DELETE,512;
D:\DELETE,512
```

- **SET KEYS=** If you enter ON as its parameter, this command turns on the command history buffer in OS/2 character-mode sessions, permitting you to scroll back and forth between previously entered commands. **SET KEYS=OFF**, the default, turns the command history buffer off.

- **SET RESTARTOBJECTS=** This is an undocumented environment variable that controls the startup action OS/2 takes with respect to applications that were active when the system was last shut down. Given its normal, ON default, OS/2 will automatically restart any applications that were open when the system stopped, returning you to where you left off. The command

```
SET RESTARTOBJECTS=OFF
```

prevents OS/2 from starting anything but the WorkPlace Shell.

You can also use

```
SET RESTARTOBJECTS=STARTUPFOLDERONLY
```

which tells OS/2 to start only the applications placed in the Startup folder on the desktop. Note that inasmuch as it is undocumented, this command may not work in future versions of OS/2.

RUN= The **RUN=** command lets you automatically load and run character-mode OS/2 applications from the **CONFIG.SYS** file. You can have more than one **RUN=** command in **CONFIG.SYS**. These commands are the last lines processed during system startup.

CONFIG.SYS

Complete Listing

```

IFS=C:\OS2\HPFS.IFS /CACHE:256 /CRECL:4 /AUTOCHECK:F
PROTSHELL=C:\OS2\PMSHELL.EXE
SET USER_INI=C:\OS2\OS2.INI
SET SYSTEM_INI=C:\OS2\OS2SYS.INI
SET OS2_SHELL=C:\OS2\CMD.EXE
SET AUTOSTART=PROGRAMS,TASKLIST,FOLDERS
SET RUNWORKPLACE=C:\OS2\PMSHELL.EXE
SET COMSPEC=C:\OS2\CMD.EXE
LIBPATH=.;C:\OS2\DLL;C:\OS2\MDOS;C:\;C:\OS2\APPS\DLL;
SETPATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL;C:\;C:\OS2\MDOS;C:\OS2\APPS;F:\OS2\UTIL;
SET DPATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL;C:\;C:\OS2\BITMAP;C:\OS2\MDOS;C:\OS2\APPS;
SET PROMPT=$I{$P}
SET HELP=F:\OS2\HELP;F:\OS2\HELP\TUTORIAL;
SET GLOSSARY=F:\OS2\HELP\GLOSS;
PRIORITY_DISK_IO=YES
PRIORITY=DYNAMIC
FILES=50
DEVICE=C:\OS2\DOS.SYS
DEVICE=C:\OS2\PMDD.SYS
BUFFERS=10
DISKCACHE=256,LW,128,AC:C
RUN=C:\OS2\CACHE.EXE /MAXAGE:2000
MAXWAIT=3
TIMESLICE=64,128
MEMMAN=SWAP,MOVE,PROTECT
SWAPPATH=F:\OS2\TEMP 2048 4096
BREAK=OFF
THREADS=256
PRINTMONBUFSIZE=256,134,134
COUNTRY=001,C:\OS2\SYSTEM\COUNTRY.SYS
SET KEYS=ON
SET DELDIR=C:\DELETE,512;D:\DELETE,512;E:\DELETE,512;F:\DELETE,512; BASEDEV=PRINT01.SYS
BASEDEV=IBM1FLPY.ADD
BASEDEV=IBM1S506.ADD
BASEDEV=OS2DASD.DMD
SET BOOKSHELF=F:\OS2\BOOK;F:\OS2\HPFSUTIL;
SET EPATH=C:\OS2\APPS
PROTECTONLY=NO
SHELL=C:\OS2\MDOS\COMMAND.COM C:\OS2\MDOS /P /E:512
FCBS=16,8
RMSIZE=640
DEVICE=C:\OS2\MDOS\VEMM.SYS
DEVICE=C:\OS2\MDOS\VMOUSE.SYS
DOS=HIGH,UMB
DEVICE=C:\OS2\MDOS\VDPX.SYS
DEVICE=C:\OS2\MDOS\VXMS.SYS /UMB
DEVICE=C:\OS2\MDOS\VDPMI.SYS
DEVICE=C:\OS2\MDOS\VWIN.SYS
DEVICE=C:\OS2\MDOS\VCDROM.SYS
DEVINFO=SCR,VGA,C:\OS2\VIOTBL.DCP
SET VIDEO_DEVICES=VIO_VGA
SET VIO_VGA=DEVICE(BVHVGA)
DEVICE=C:\OS2\MDOS\VVGA.SYS
DEVICE=C:\OS2\POINTDD.SYS
DEVICE=C:\OS2\MOUSE.SYS SERIAL=COM2
DEVICE=C:\OS2\COM.SYS
DEVICE=C:\OS2\MDOS\VCOM.SYS
CODEPAGE=437,850
DEVINFO=KBD,US,C:\OS2\KEYBOARD.DCP
IOPL=YES

```

Figure 1: This sample OS/2 CONFIG.SYS file illustrates the recommendations made in Parts 1 and 2 of this article.

The RUN= command is most commonly used to start the HPFS CACHE. Some LAN drivers can also be started using RUN= instead of being loaded in STARTUP.CMD; the manuals will tell you if this is the case. RUN= is also used to start up special services, such as LAN file servers or database servers. The text after RUN= should comprise the full

pathname of the application and any parameters needed; see the discussion of CACHE above for an example.

VERIFY= This command tells OS/2 to verify that a file was written to disk correctly by immediately comparing it with the original. This is equivalent to using the /V option on the COPY and XCOPY command lines. The default is OFF. If

you store a lot of critical data, or if your system is being used as a concurrent LAN or database server, set VERIFY=ON.

BRINGING IT ALL TOGETHER Figure 1 consists of a sample OS/2 2.0 CONFIG.SYS file that has been tuned for best performance on an 8MB 486/33 system. The system has a VGA monitor and a mixture of FAT and HPFS partitions on

a 420MB hard disk. Drives C:, D:, and E: are FAT, and F: is HPFS. The system boots from C:. As you examine the figure, note the following points as a guide to tuning your own OS/2 system:

- The first step is to move the location of the swap file from the boot drive to one that has more room. As you can see in the example, SWAPPATH is set to a subdirectory on the HPFS drive F:.
- UMBs are activated for DOS and Windows sessions by the addition of the /UMB parameter on the

```
DEVICE=C:\OS2\MDOS\VXMS.SYS
```

line. DOS=HIGH,UMB lets the built-in DOS interpreter load itself into the UMBs and permits loading device drivers and TSRs into the UMB with DEVICE-HIGH and LOADHIGH commands.

- The HPFS and FAT disk caches are sized according to the recommendations in Part 1. The HPFS cache is further tuned by reducing the amount of time it waits to write data to the disk by using the /MAXAGE:2000 parameter on the

```
RUN=C:\OS2\CACHE.EXE
```

line. BUFFERS have been reduced to 10 in accordance with IBM's recommendation. Lazy writes are turned on for the FAT drives through the addition of LW after the DISKCACHE command. This speeds up the file system performance.

- The PRINTMONBUFSIZE= command enhances printer performance on LPT1 by increasing the buffer to 256 bytes. This setting is fine for a laser printer; for a dot-matrix printer, 512 would be better.

- All on-line help files and reference manuals have been moved to the HPFS drive both to free disk space on the boot drive and to speed up searches.

- Finally, OS/2 is given full control over memory management and multitasking by using the MEMMAN=, the PRIORITY_DISK_IO= and the PRIORITY= commands. The TIMESLICE= values are raised to 64 and 128 (which appears as 64,128 on the CONFIG.SYS line), to provide smoother operation of foreground and background applications

when the system has to swap committed memory to disk.

The correct settings for your particular needs may vary from those shown in Figure 1. You must be willing to experiment a little, to try different values for the various settings until you strike your own balance between performance and memory usage. The best way to check memory usage is by monitoring the size of your SWAPPER.DAT file. If SWAPPER.DAT consistently gets much larger than its initial value after you've started only one or two applications, you should lower some of the values that affect the amount of memory used by the system.

The guidelines I've presented can serve as the starting point for your own explorations. The goal is to make the system's operations as smooth as possible, so it spends more time processing applications and less time swapping data to the disk. □

JOE SALEMI IS A CONTRIBUTING EDITOR TO PC MAGAZINE.



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Installing Your Application Is Easy with PC-SETUP

BY ETHAN WINER

Distributing in-house or shareware programs and file updates can produce corporate chaos when novices have to install files into multi-layer directories. Commercial-scale installation utilities guide the unsophisticated user safely through the process, but these are often too elaborate and expensive a solution for smaller-scale programmers. Engineers, hobbyists, and database services that distribute data files regularly by subscription need an install utility scaled to their needs.

If you've got too many users to go from machine to machine and make the installation yourself, yet you're not confident that these users won't mess up the installation if you don't, what you need is PC-SETUP.

PC-SETUP is designed to install any number of program or data files that have been compressed with the shareware utility PKZIP. It supports multiple distribution disks and will use or create any needed directories and subdirectories on the user's hard disk. File installation can be automatic or manual, and you can include comments to guide the user. After the first installation, there is no need to repeat the procedure in order to install a different printer driver or other optional files. And best of all, no printed user instructions are necessary.

The utilities and programs that appear in *PC Magazine* may neither be distributed for a fee nor included in a commercial product. However, because of its purpose PC-SETUP is in a somewhat different category. While it may not be sold by itself, PC-SETUP may be distributed with any software—including commercial programs—*provided no additional fee is charged.*

PC-SETUP requires a minimum of

256K RAM and DOS 3.0 or later. DOS 3.0 is necessary because PC-SETUP uses interrupt services that are not available in earlier DOS versions. In addition to PC-SETUP.EXE, you must also have a copy of PKUNZIP.EXE on your first (or only) distribution disk. PKUNZIP is a shareware program that is available for downloading on CompuServe and other bulletin boards. Note that if it is included with commercial software, PKWARE Inc. requires a nominal license fee. (To register PKUNZIP, send \$47 to PKWARE Inc., 9025 N. Deerwood Dr., Brown Deer, WI 53223. To inquire about licensing fees, call 414-354-8699.)

The fastest way to get PC-SETUP in both executable and source code form is

*Here's an installation
utility designed specifically
with the software
distributor in mind.*

to download the file PC-SET.ZIP from PC MagNet, as explained in the "Utilities by Modem" sidebar. The program was written using Microsoft QuickBASIC 4.5. To recreate PC-SETUP from the supplied source code, you need QuickBASIC 4.0 or any later version of Microsoft compiled BASIC (including VB-DOS). When linking, you must specify the appropriate library name so that LINK can find the interrupt routine PC-SETUP uses. The correct syntax and library names are shown below:

```
BC PC-SETUP /O ;  
    use above line for all versions  
LINK PC-SETUP, , NUL, QB.LIB ;  
    use above line for QuickBASIC
```

```
LINK PC-SETUP, , NUL, QBX.LIB ;  
    use above line for BASIC PDS  
LINK PC-SETUP, , NUL, VBDOS.LIB ;  
    use above line for VB-DOS
```

If you don't have a modem, you can request the files on-disk. Just send a *postcard* with your name, address, and preferred disk size to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016. No phone calls please.

USING PC-SETUP To begin installing from your distribution disk, the user simply enters `d:PC-SETUP [/B]` where `d:` is the drive containing the .ZIP files to be decompressed and installed. PC-SETUP detects whether a color or monochrome adapter is present and adjusts its display colors accordingly. The optional `/B` switch is needed only for systems with a composite display, that is, a CGA adapter connected to a monochrome monitor.

The three parts of the main PC-SETUP screen display the names of the .ZIP files to be installed, the drive and directory into which they will be stored, and an optional comment that will usually be used to describe each file's contents. On-screen instructions explain each of the keys that are used by PC-SETUP, and pop-up dialog boxes are used for any warnings. A brief status message shows the name of each file as it is being installed, further clarifying the program status.

As explained below in the section "Setting Up for Installation," you may elect to have one or all of your distribution files installed automatically. Assuming that the user is (or wants) instead to make the installation manually, he selects each .ZIP file to be installed by pressing the Spacebar. A check mark adjacent to the currently highlighted .ZIP filename

■ PC Magazine Utilities Updates

As with all good software, the programs presented in *PC Magazine* are upgraded and improved. Here's a partial list of the programs on PC MagNet that have been updated. To download these files from the Utilities/Tips Forum, type GO ZNT:TIPS, type LIB or select Libraries from the menu, then select Library 2 PCMAG UTILS. Type DOW and the filename listed below (for example, DOW ANSI.COM), or select Download a File from the menu.

ADDIT.COM, Version 1.1
ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.5
BCOPY.COM, Version 1.2
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.7
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 3.1

EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
PCACCESS.EXE, Version 1.1
RN.COM, Version 3.0
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
ZCOPY.COM, Version 1.4

For a list of the programs that are available on PC MagNet, download the file PCMCAT.ZIP from Library 1 (General Info) of the Utilities/Tips Forum.

A downloadable index to *PC Magazine's* product reviews is also available in Library 1 (General Info). PCM.EXE is a self-extracting file containing the Computer Library *PC Magazine* Reviews Index for January 1988 through December 1991. It requires the search files in PCSRCH.EXE.

is turned on or off each time the Spacebar is pressed.

By default, PC-SETUP lists the current directory as the destination directory. If this is not correct, the user can enter the destination directory of his choice: The Tab key toggles between selecting .ZIP files for installation and editing the destination directories. If the user enters a destination directory that does not exist, PC-SETUP will create it. When installing to an existing directory, the program asks whether to warn before overwriting same-named files.

Once all the desired files are marked and destined, the user presses F2 to begin installation. To exit from PC-SETUP, a simple press of the Esc key will suffice. These options are shown at the bottom of the main screen, and operating PC-SETUP should be easy enough for even the most inexperienced user.

SETTING UP FOR INSTALLATION Your installation can use a maximum of 99 distribution disks, each of which may contain up to 19 .ZIP files. No single .ZIP file can be larger than the maximum capacity of a single distribution floppy disk, however. You are not restricted to using the root directory of the disks, though you must be sure to place PC-

SETUP.EXE in the same directory as PKUNZIP.EXE. Both of these files must be located on the first distribution disk, together with your .ZIP files.

If your installation takes more than one disk, you must create a file named NUMDISKS.*n* on the first distribution disk—the one that you label as "Disk 1." The NUMDISKS extension, shown above as *n*, indicates the total number of disks and enables PC-SETUP to prompt for additional disks as they are needed. The file itself can be empty; the filename and extension *are* the information. If you're operating under DOS, the easiest way to create an empty NUMDISKS file from the DOS command line is like this:

```
REM > A:NUMDISKS.004
```

SETTING DESTINATION DIRECTORIES In preparing your distribution disks, there are several ways to establish the default destination drive(s) and directories for the files to be installed.

- If you do nothing at all, the user's current drive and directory will be displayed in the "Destination Directory" field for each of the files being installed. However, if the current drive is A: or B:, PC-SETUP will substitute Drive C:. The util-

ity won't attempt to unpack the files onto the distribution disk.

- You can specify a directory as the global default destination directory by including a file named DEFAULT.DIR in the root directory of the first distribution disk. The one-line contents of this file specify the path for all of the .ZIP files. You can create DEFAULT.DIR, either with any standard text editor that saves files in plain ASCII form or directly from the DOS prompt, by entering

```
COPY CON: A:DEFAULT.DIR  
C:\PRODUCT
```

and then hitting F6 followed by Enter. (F6 puts a Ctrl-Z, or end-of-file marker at the end of DEFAULT.DIR.)

- You can embed a directory name in the comment field provided for each file by PKZIP. Such an embedded directory name will override the global directory specified in the DEFAULT.DIR file (if one is present). To see how PC-SETUP works with PKZIP in such a case calls for a brief explanation.

Comments can be added to .ZIP files by executing the command

```
PKZIP filename.zip -z
```

Normally, your comment might be, for example, "This is the main program." PC-SETUP displays such comments in its right-hand column, so the user can know the purpose of a particular .ZIP file.

In place of or appended to such a comment, you can embed a default destination path by entering the box character (ASCII 254), followed by the drive and directory. Thus, for example,

```
This is the main program■C:\DIRNAME
```

The comment will be displayed in the usual manner, but PC-SETUP will put the drive and directory in the left-hand, Destination Directory field. You can enter the box character at the DOS command prompt (and in most editors) by holding down the Alt key, typing 2, 5, and 4 on the numeric key pad, and then releasing the Alt key.

Note that whichever of the three methods you use to supply a default destination directory, users can override your



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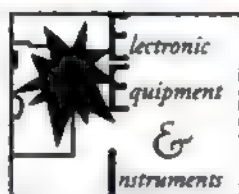
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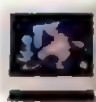
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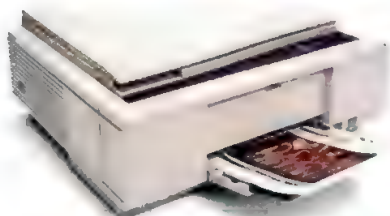
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Canon

suggestion and specify a different drive and directory of their own choosing.

SELECTING FILES FOR INSTALLATION In some cases your users may not want or need to install all of the files on the distribution disks. For example, some companies provide source code with their products, but many people aren't interested in programming languages and may prefer not to waste their disk space with such files. Or perhaps you distribute software that works with a variety of printers, and only one or two of several supplied drivers will be used by each customer.

To have a file selected for installation automatically, append an ASCII 251 check mark (✓) to the end of the comment string, but before the optional box character and destination path. Three examples cover the possibilities:

This is the main program✓■C:\DIRNAME

or

This comment has no default path✓

or

✓■C:\PATHNAME

Files whose comments have no trailing check mark will not be automatically installed when the program runs, although the user may, of course, select those files manually. Again, you can enter the check mark by pressing and holding the Alt key, and then typing the digits 2, 5, and 1 when PKZIP prompts you to enter the .ZIP file comment.

The comment portion (before the box and optional check mark) can be up to 36 characters long, and the directory name portion of the comment (after the box) can hold as many as 25 characters. (To make the comment field as long as possible, I compromised on using only 25 characters for the directory name.)

You can tell PC-SETUP to run a program automatically after PC-SETUP finishes by storing its name in a file named PROGRAM.RUN placed on the first distribution disk. The name of the program must be no longer than 14 characters, since PC-SETUP stuffs the program name (plus Enter) into the keyboard buffer. PC-SETUP is smart enough to

StuffBuf Subprogram

Complete Listing

```

DEFINT A-Z
SUB StuffBuf (Cmd$) STATIC

'----- Set the segment for poking, define the buffer head and
'         tail, then poke each character into the keyboard buffer.

Temp = LEN(Cmd$)

DEF SEG = 0
POKE &H41A, &H1E
POKE &H41C, &H1E + Temp * 2
FOR X = 1 TO Temp
    POKE &H41C + X * 2, ASC(MID$(Cmd$, X))
NEXT

END SUB
    
```



Figure 1: The StuffBuf subprogram pokes the characters that comprise the program name to be run directly into the PC's keyboard buffer.

change to the directory where the first .ZIP file was installed, on the assumption that this directory will hold the main executable program.

If you need to execute a series of commands—for example, to load a TSR that must be present in order for the main program to operate—you can include a batch file within the .ZIP file and specify the name of the batch file in PROGRAM.RUN. Such a batch file should be in the same .ZIP file that holds the main program, so it will be installed where DOS can find it when PC-SETUP ends. Note that the program or batch file specified in PROGRAM.RUN is executed only when the first .ZIP file on the disk is being installed: If PC-SETUP is rerun to install a new printer driver, for example, it would be inappropriate to run the main program at that point.

INSTALLING TO NESTED DIRECTORIES The only precaution you must take when your software is to be installed into nested directories is to specify that the higher directory levels be installed first. PC-SETUP will create the directories needed if they are not already present, but it must work from the top down. For example, if you have main files that should go into \APPMAN and ancillary files that are to go in \APPMAN\SUBDIR, PC-SETUP has to create \APPMAN before it can create \APPMAN\SUBDIR.

If you are careful to copy the .ZIP files on your distribution disk(s) in the correct order, this will not be a problem. Unfor-

tunately, it is still possible for a user to create problems by changing the directory names during installation. There is little that can be done about this and if PC-SETUP is unable to create a directory, it simply ends with an error message describing the problem. Note: If you include a DEFAULT.DIR file, it should specify a root-level directory only (with a leading backslash) unless you are certain that the upper levels already exist.

PROGRAMMING CONSIDERATIONS Three programming techniques used in PC-SETUP call for discussion: the keyboard buffer stuffer used to free memory for executing a program immediately after its installation; the DOS Exec function; and the method used to determine the name of the executing program.

PC-SETUP uses two different methods to execute other programs. When PC-SETUP runs PKUNZIP, it uses the DOS Exec function so that any errors can be detected (this will be described later). The problem that arises is that the DOS Exec function is invoked as a subroutine, and the calling program remains in memory while a subsequent program is run. Since PC-SETUP offers the option of running an application immediately after its installation, it's important to make as much memory as possible available to it.

The solution I used to avoid this limitation is to stuff the name of the program to be run into the PC's keyboard buffer just before ending PC-SETUP. This has the same effect as if the operator manually entered the program's name just af-

ter PC-SETUP finished. Note, however, that this technique will not work if PC-SETUP is run from a batch file. You must make sure that PC-SETUP is run directly if you intend to use the "run immediately" option.

The PC BIOS routines maintain a 15-character keyboard buffer in low memory. This is what lets you type while the PC is doing something else. When the DOS command line or a running program looks to see what keys were pressed, the characters you entered are present. The StuffBuf subprogram, which is listed in Figure 1, manipulates the keyboard buffer by entering commands directly into the keyboard buffer's memory locations.

StuffBuf begins by setting the segment for its subsequent POKE commands to the bottom of the PC's memory. It then sets the buffer head and tail pointers, which together indicate the length of the command being entered. Finally, the characters in Cmd\$ are poked into the buffer in a FOR/NEXT loop.

Notice that the characters are not entered into consecutive memory locations. Two bytes are reserved for each key so as to accommodate extended keys, such as the cursor arrows and the function keys. Therefore, only the first location of each address pair is used. Also note that it is up to the caller to append an ASCII 13 (Enter) character to the end of the string and to ensure that no more than 15 characters are included. This is handled in PC-SETUP at the point where

RunName\$ is read from the PROGRAM.RUN text file.

THE DOS EXEC FUNCTION The simplest way to have one BASIC program run another is to use the BASIC SHELL command. Unfortunately, however, SHELL cannot report exit codes from the program being run to the BASIC caller. PKUNZIP uses the DOS ERROR-LEVEL facility to return its success or failure in an exit code. (This feature is normally intended to let you test what happens when PKUNZIP is run from a batch file.) Fortunately, however, by using DOS interrupt calls it is possible to execute programs and retrieve their exit codes behind BASIC's back.

In designing PC-SETUP, I needed to know whether PKUNZIP was able to unpack the files successfully and, if not, to report the error. To accomplish this I found it necessary to write a replacement for BASIC's SHELL that would include the ability to retrieve PKUNZIP's exit code. This is the purpose of the Execute function, which is listed in Figure 2. Although the discussion of Execute that follows assumes that PKUNZIP is being run, you can also use this function in BASIC programs of your own to run any executable program file.

If you decide to add Execute to your programs, you must pay careful attention to the shared variables that are used. These are Regs (defined as RegType), DOS, ZBuffer\$, and Zero\$. These variables are defined in the main portion of the PC-SETUP program, and the rele-

vant DIM SHARED statements must also be copied into your main program.

Execute begins by defining two fixed-length strings. The first holds the DOS parameter block that is built by Execute. The second holds the command-line parameter arguments being passed to PKUNZIP. Fixed-length strings are used because they are always in near memory (DGROUP). This allows the same code to work both with near strings (QuickBASIC) and far strings (BASIC PDS and VB-DOS).

The function's next step is to append a CHR\$(0) zero byte to a copy of the program name (PKUNZIP.EXE). Strings with trailing zero bytes are called ASCIIZ strings, and ASCIIZ is the format DOS expects for all strings that are passed to it. Because ASCIIZ strings are employed repeatedly throughout PC-SETUP, a global shared buffer (ZBuffer\$) is used for the purpose of adding the CHR\$(0). ZBuffer\$ is defined near the beginning of the PC-SETUP source code; it is also fixed-length so that it can work with both near and far strings.

The DOS Execute service expects the complete name of the program (including its .COM or .EXE extension), together with a full path. This particular DOS service will not search the PATH environment variable for programs, so you must provide this information explicitly if the program is not in the current directory of the current drive.

The next two steps in the function assign the parameter text and parameter

Execute Function

Complete Listing

```

DEFINT A-Z
FUNCTION Execute% (Program$, Parameter$) STATIC

'---- Prepare the program name and parameter strings for
' processing. DOS requires that the parameter string hold
' the length of the parameter text, followed by the
' parameter text, and then followed by a CHR$(13)
' Enter byte. The parameter block is comprised of 14
' bytes. The first two bytes are the address of the
' environment block for the child program. If they are
' 00 00, the child gets an exact copy of the parent's
' environment. These bytes are then followed by the
' address and segment of the parameter string.

DIM Block AS STRING * 14      'this is the DOS parameter block
DIM Parm AS STRING * 50      'and this is the parameter text

ZBuffer$ = Program$ + Zero$  'make an ASCIIZ string for DOS

LSET Parm$ = CHR$(LEN(Parameter$)) + Parameter$ + CHR$(13)
LSET Block$ = Zero$ + Zero$ + MKI$(VARPTR(Parm$)) + _
MKI$(VARSEG(Parm$))

Dummy% = SETMEM(-500000)      'free memory for PKUNZIP

Regs.AX = &H4B00              'DOS load/execute function
Regs.DX = VARPTR(ZBuffer$)    'offset of program name into DX
Regs.EI = VARSEG(Block$)      'segment of param. block in ES
Regs.BX = VARPTR(Block$)      'offset of param. block in BX
Regs.DS = -1                  'set DS to BASIC's segment
CALL InterruptX(DOS, Regs, Regs) 'execute it
'CALL InterruptX(DOS, Regs)    'use this with P.D.Q.

IF Regs.Flags AND 1 THEN      'DOS error trying to run PKUNZIP
    Execute% = -Regs.AX        'set function value to exit code
    EXIT FUNCTION
END IF

Regs.AX = &H4D00              'retrieve DOS exit code
CALL Interrupt(DOS, Regs, Regs) 'use this with P.D.Q.
'CALL Interrupt(DOS, Regs)    'use this with P.D.Q.
Execute% = Regs.AX            'set function value to exit code

Dummy% = SETMEM(500000)       'reclaim the memory

END FUNCTION

```

Figure 2: The Execute function serves the same general purpose as does BASIC's SHELL command, but it returns the exit code of the program that was run.

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QUICK REFERENCE CARD

PC-SETUP.EXE Command

Ethan Winer

March 16, 1993 (Utilities)

Purpose: An installation program for in-house programmers, shareware authors, data services, and others who distribute software to nontechnical users. Supports multiple distribution disks, and automatic or manual file installation. Creates directories and subdirectories as necessary. Requires use of PKZIP.EXE on all distribution files, and DOS 3.0 or later.

Format: `d:PC-SETUP [\B]`

Remarks: Either A: or B: will normally be the drive *d:* on which PC-SETUP is located. The \B parameter is needed only when a CGA adaptor is used with a monochrome monitor.

The single PC-SETUP screen display provides columns showing the directory destination, the filename, and any comments you include in the .ZIP file. The Tab key permits changing the default destination drive and directory, the Spacebar marks or unmarks files to be decompressed and installed, and F2 begins the installation process. ESC exits the program.

In preparing distribution disks, be sure that PC-SETUP and PKUNZIP.EXE are in the same directory and on Disk 1. If multiple distribution disks are used (99 are supported, each with up to 19 .ZIP files), Disk 1 must also contain a file named NUMDISKS.*n*, *n* being the number of such disks. Disk 1 may also contain a file named DEFAULT.DIR that specifies a destination path other than the user's current directory. A PROGRAM.RUN file on Disk 1 specifies a batch file or program to be run immediately after the installation.

The command `PKZIP filename -z` is used to make entries (up to 36 characters) in the comment field. If a comment ends with an ASCII 251 character (v), the associated file will automatically be selected for installation without user intervention. To specify a destination path (up to 25 characters) for a file, append an ASCII 254 character (■), followed by the path, to the comment. You can enter these ASCII characters by holding down the Alt key and typing the numbers on the numeric keypad.

In arranging files on the distribution disk(s), note that PC-SETUP must create directories before it can create their subdirectories. It warns you if same-named files in existing directories will be overwritten.

The ExeName Function

Complete Listing

```

DEFINT A-Z
FUNCTION ExeName$ STATIC

'Returns the name of the currently running program.
'Requires DOS 3.0 or later.

'---- DOS Interrupt &H21 service &H62 returns the PSP segment
'   in the BX register.
Regs.AX = &H6200
CALL Interrupt(DOS, Regs, Regs)
CALL Interrupt(DOS, Regs) 'use this with P.D.Q.

'---- The environment segment is at addresses &H2C/&H2D in
'   the PSP segment.
DEF SEG = Regs.BX
DEF SEG = PEEK(&H2C) + PEEK(&H2D) * 256

'---- Search the environment segment for two zero bytes in
'   a row. A count word (which we skip over) follows
'   that, and the program name follows the count word.

Byte = 0
DO
  IF PEEK(Byte) = 0 THEN 'this is zero
    IF PEEK(Byte + 1) = 0 THEN 'this is too
      Byte = Byte + 2 'so skip both
      EXIT DO 'all done
    END IF
  END IF 'else,
  Byte = Byte + 1 'keep looking
LOOP

IF PEEK(Byte) = 1 THEN 'if this count byte = 1
  Byte = Byte + 2 'the name follows
  DO WHILE PEEK(Byte) 'up to another zero
    Tmp$ = Tmp$ + CHR$(PEEK(Byte))
    Byte = Byte + 1
  LOOP
  ExeName$ = Tmp$ 'assign function output
END IF

END FUNCTION

```



Figure 3: The ExeName function returns the full pathname of the calling program, telling the program which drive and directory it resides on.

block in the format DOS requires. The parameter text is stored in a string whose first byte indicates the length of the subsequent text. This byte is followed by the parameter text, which in turn is followed by a CHR\$(13), the Enter character.

The parameter block comprises 14 bytes. The first 2 bytes are the address of the environment block for the child program. If these are 00 00, the child will get an exact copy of the parent's environment. Next comes the 2-byte address of the parameter text, which is followed by the 2-byte segment of the parameter text. The 8 remaining bytes aren't of concern.

BASIC programs take over all available DOS memory when they begin, so Execute must release as much memory as possible before it can run PKUNZIP. When you use SHELL, BASIC releases all of the memory that your program has not used before SHELL was executed. In this case, however, the release must be done manually, and Execute uses the SETMEM function for the purpose. (The SETMEM value of 500000 was chosen arbitrarily; in practice, less memory will be released.) Execute then sets up the CPU registers to invoke the DOS Load and Execute Interrupt services. If there isn't enough memory to run PKUNZIP, DOS returns with the CPU's Carry flag set. Execute tests for this by using BASIC's AND operator.

The function's final steps are to call DOS once again to retrieve the result code and then to reclaim the memory relinquished earlier. The result code is assigned as the function's output, so it can

be tested by the main portion of PC-SETUP.

DETERMINING THE PROGRAM NAME It is not necessary to log on to the floppy disk drive on which PC-SETUP resides. Like other DOS programs, PC-SETUP can be run from the command prompt by giving the drive letter before its name, for example: A:PC-SETUP. To work properly when run this way, however, PC-SETUP needs to know where it is. Otherwise, it won't know where to look for PKUNZIP and for the .ZIP files to be installed. The ExeName function listed in Figure 3 is designed to return the full name of the currently executing program, including the drive letter and pathname. Thus, for example, if PC-SETUP is being run from the root directory of drive B:, ExeName will return B:\PC-SETUP.EXE. In this case, PC-SETUP needs only the drive letter, so the rest of the string is stripped off after ExeName is invoked.

ExeName uses DOS interrupt service &H62 to obtain the program's PSP (program segment prefix) segment. This is one of the reasons why PC-SETUP requires DOS 3.0 or later. (Another is that when PKUNZIP.EXE is executed, its name is preceded by a path. In DOS 2.x you could not specify the full pathname of a program at the DOS prompt.)

The program's environment segment is contained at offset 2Ch of the PSP. The environment puts the program's full pathname after all of the environment variables. DOS makes a copy of the environment for each program, and at the end of this copy (signaled by two 00 bytes)

there is a 0001 Word and the full pathname.

If the master environment is large enough to hold 512 bytes but only 100 bytes are being used by environment variables, the copy DOS creates will be only 100 bytes long. DOS then adds a pair of zero bytes to mark the end of the environment. These are followed by 2 more bytes that tell how many other strings are to follow, after which comes the full name of the program (also terminated by a zero byte). After ExeName obtains the environment segment address, it walks through each of the environment variables, looking for the double-zero bytes that mark the end. It then skips over the count word and reads and returns the program name as the function output.

ExeName can be a valuable tool to use in other programs you may write. If your program is located in one directory but is run from another directory, the same path setting that allows DOS to find it will allow ExeName to find your data or configuration files. If, like some programmers, you store configuration information directly within an executable file, ExeName will not only tell you where the program resides, but will also let you read from and write to the program file even if it has been renamed.

Both in its programming techniques and in its function as a utility, I think you'll find PC-SETUP a time- and frustration-saving adjunct to your work. □

ETHAN WINER IS A CONTRIBUTING EDITOR TO PC MAGAZINE.

Paragraph Formatting and Text Justification Under OS/2

BY CHARLES PETZOLD

I don't know about you, but for me the idea of writing a modern word processor for a graphical environment such as the OS/2 Presentation Manager is downright scary. Users have come to expect both ease of use and sophistication from such software, and these goals are often at odds. And knowing the folks at *PC Magazine* who review word processors, I would be hesitant about creating a product that could withstand their incisive scrutiny!

Still, one of the objectives of learning how to work with fonts under OS/2 is to understand how graphical word processors do what they do, and to imitate some of that in our own applications. If, after this series of articles, you won't be entirely equipped to write the next major PM word processor, at least you'll be ready to display formatted text in your other PM programs.

FORMATTING OPTIONS I mention word processors because they illustrate clearly many of the options you can use in displaying text. At the very least, word processors divide formatting into two major categories: character formatting and paragraph formatting. If you look at the menus or dialog boxes of your word processor, you'll find that character formatting involves (at the very least) the selection of a font and point size and the setting of character attributes—italics, boldface, underlines, and strike-outs. In previous columns we've seen how to select bitmap fonts, point sizes, and attributes using the OS/2 bitmapped fonts. In future columns, we'll examine how to select outline fonts.

Of course, word processors often support other character attributes, specifically subscripting and superscripting, and perhaps small capitals (where a word is displayed entirely in capital letters but at

a smaller size than normal). Because these attributes usually require changing the font point size by a specific percentage of the normal point size, bitmapped fonts are often not suitable for these formatting options. I'll examine these options when we switch our focus to outline fonts in future columns.

Paragraph formatting determines the way in which a paragraph is displayed. This involves such options as indentation,

A sample program illustrates how to implement character- and paragraph-formatting options under the OS/2 2.0 Presentation Manager.

line-spacing, and alignment.

In this column, I'd like to illustrate how to implement line-spacing and alignment options under the OS/2 Presentation Manager. Although many modern word processors (and, to a greater extent, desktop publishing programs) allow very specific line-spacing options, I'll be illustrating the traditional, simple ones: single-spacing, double-spacing, and the compromise—spacing by 1.5 lines.

I'll also show how to do the four standard types of paragraph alignment: left, right, centered, and justified. Of course, you can probably guess that justified text (in which each line of text occupies the full space in the text column, such as in this magazine) is the most difficult. As we'll see, however, the OS/2 GPI (Graphics Programming Interface) provides a couple of functions that make displaying

justified text a lot easier than it would be otherwise.

Paragraph formatting relies heavily on the `GpiQueryTextBox` function, so it might be useful to review it briefly:

```
GpiQueryTextBox (hps, lNumChars,
                 pString, lNumPts, aptl);
```

As usual with GPI functions, the first parameter is a handle to the presentation space. The function reports information about the font currently selected in the presentation space for a particular character string pointed to by `pString`. The `lNumChars` parameter indicates the number of characters in the string. The `lNumPts` parameter is almost always set to the constant `TXTBOX_COUNT`, which equals 5. The last parameter is an array of five `POINTL` structures.

The `GpiQueryTextBox` function assumes the character string will be displayed beginning at the point (0,0). This point corresponds to the baseline at the left side of the first character. On return from the function, the first four elements of the array of `POINTL` structures indicate (in world coordinates) the four corners of a box that entirely encloses the character string, relative to the point (0,0). You can reference these points using the constants `TXTBOX_TOPLEFT`, `TXTBOX_BOTTOMLEFT`, `TXTBOX_TOPRIGHT`, and `TXTBOX_BOTTOMRIGHT`. In addition, you can use the constant `TXTBOX_CONCAT` to reference the last `POINTL` structure in the array. This is the text concatenation point—the point corresponding to the baseline of the right side of the last character.

The number `aptl[TXTBOX_TOPLEFT].y` is the height of the text box above the baseline. This corresponds directly to the `lMaxAscender` field of the

JUSTIFY.MAK

Complete Listing

```

#-----
# JUSTIFY.MAK make file
#-----

justify.exe : justify.obj bmf.obj justify.def justify.res
             link386 /BASE:0x10000 justify bmf,, NUL,, justify
             rc justify.res

justify.obj : justify.c justify.h bmf.h
             gcc -C -Kbcpr -Ss justify.c

bmf.obj : bmf.c bmf.h
             gcc -C -Kbcpr -Ss bmf.c

justify.res : justify.rc justify.h justify.txt
             rc -r justify.rc

```



Figure 1: This is the make file for JUSTIFY.EXE.

FONTMETRICS structure for the font. Similarly, `aptr[TEXTBOX_BOTTOMLEFT].y` is the descent of text box below the baseline. The negative of this value is the same as the `lMaxDescender` field of the FONTMETRICS structure. As we've seen in previous columns, the sum of `lMaxAscender` and `lMaxDescender` is equal to the FONTMETRICS field `lMaxBaselineExt`, which by extension is equal to `aptr[TEXTBOX_TOPLEFT].y` minus `aptr[TEXTBOX_BOTTOMLEFT].y`.

For most fonts, `lMaxBaselineExt` is about 120 percent of the point size, a normal value for spacing successive lines of text, and what I'll be using in the program shown later in this column.

ALIGNING TEXT You can also use `GpiQueryTextBox` for determining the width of a character string using the `aptr[TEXTBOX_CONCAT].x` value. This is what you use for breaking a paragraph into successive lines of text.

Let's assume you have a single paragraph of text stored in memory and terminated by a carriage return character. For purposes of simplicity, let's assume that none of the individual words in the paragraph contain any character formatting, and there are no hyphenated words or anything like that. The paragraph just consists of words separated by spaces.

You need to display this paragraph in a rectangle. The top of the rectangle determines the vertical starting point of the text, and the width of the rectangle is the column width in which the text must fit.

Whether you want left, right, cen-

tered, or justified alignment, the initial process is the same and conceptually quite simple. You begin with the beginning of the paragraph and search for the first space character. Then, using `GpiQueryTextBox`, you find the width of the string before that space character. This is the width of the first word of the para-

graph; most likely, it will be less than the column width. So, you search for the next space character and find the width of the first two words (and the space between them) together. You keep doing this until the width of the text is greater than the column width. Then you back up one word, and that's your line break.

Now you have the substring that will be displayed as the first line of the formatted paragraph, and you can continue with the second line.

Regardless of the character alignment you choose, any particular line in the formatted paragraph will have the same number of words. The width of the text in each line will be less than or equal to the column width. Let's call the difference the "surplus space." The only difference between the four character alignments is where this surplus space goes.

With left-aligned text, the surplus space appears at the right side of the column; with right-aligned text, it appears at the left; with centered text, it's divided equally between the left and right sides. And with justified text, the surplus space is... well, let's think about it.

BREAK AND CHARACTER SPACE For justified text, your immediate instinct might be to divide the surplus space between all the characters in the string. However, the publishing convention is to justify the text line by distributing the extra space not between each character, but in the spaces between the words. That is, all the space characters in the line are made slightly wider by an equal amount.

Fortunately, there's a GPI function

that sets a device context attribute that performs precisely this job with a minimum of fuss:

```
GpiSetCharBreakExtra (hps, fxExtra);
```

The second parameter is a 16-bit FIXED value. It's a fixed-point number with an integral part in the high 16 bits and a fractional part (that is, a fraction of 65536) in the low 16 bits. You can convert an integer to a FIXED number by multiplying it by 65536.

After you call this function, any text displayed has a space character that is wider by `fxExtra` than the normal space character. Calculate `fxExtra` by multiplying the surplus space by 65536 and dividing by the number of spaces in the text.

Of course, there's always the possibility that only one word fits in the column. This can happen very easily when you're writing about the OS/2 Presentation Manager and bandying about such words as `GpiQuerySegmentTransformMatrix`. Sometimes such a word will be hyphenated and straddle two columns, but it could happen that all (or part) of it will nearly fill the full-column width and no other word can appear there. In this case, you can't use `GpiSetCharBreakExtra` because there are no spaces in the line. Thus, you need to insert extra spaces between the characters. And again GPI provides a hassle-free function to do it:

```
GpiSetCharExtra (hps, fxExtra);
```

In this case you calculate `fxExtra` by multiplying 65536 by the surplus space and dividing by the number of characters in the word, less 1.

Interestingly enough, `GpiSetCharExtra` also solves the problem of a text line containing a single word that is too wide to fit in the column. This might happen if you're writing about `GpiQuerySegmentTransformMatrix` and haven't implemented any hyphenation logic. If the surplus space is negative, so too will `fxExtra` be, and `GpiSetCharExtra` will scrunch up the text. It might not look that great, but at least it will still be within the boundaries of the column.

THE SAMPLE PROGRAM Now that we know the theory, let's look at a simple implementation. The JUSTIFY program

PC WINDOWS RAPID APPLICATION DEVELOPMENT

Small, E.Y. Swann and George J. Fethak

Windows has become the standard for desktop applications. It's time to learn how to develop Windows applications. This book shows you how to develop Windows applications using the Visual Basic programming language. It covers the basics of Windows programming, from creating a simple window to developing complex applications. It also covers the basics of the Windows API, so you can develop applications that use the full power of Windows.

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CIRCLE 354 ON READER SERVICE CARD

JUSTIFY.C

1 of 2



```

/*-----
JUSTIFY.C -- Justify Bitmap Fonts
(c) Charles Petzold, 1993
-----*/

#define INCL_WIN
#define INCL_GPI
#define INCL_DOS
#include <os2.h>
#include "justify.h"
#include "bmf.h"

#define LCID_PONT 1L

MRESULT EXPENTRY ClientWndProc (HWND, ULONG, MPARAM, MPARAM) ;

int main (void)
{
    static CHAR szClientClass [] = "Justify" ;
    static ULONG flFrameFlags = FCF_TITLEBAR | FCF_SYSMENU |
                                FCF_SIZEBORDER | FCF_MINMAX |
                                FCF_SHELLPOSITION | FCF_TASKLIST |
                                FCF_MENU ;

    HAB hab ;
    HMQ hmq ;
    HWND hwndFrame, hwndClient ;
    QMSG qmsg ;

    hab = WinInitialize (0) ;
    hmq = WinCreateMsgQueue (hab, 0) ;

    WinRegisterClass (hab, szClientClass, ClientWndProc, CS_SIZEREDRAW, 0) ;

    hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                    &flFrameFlags, szClientClass, NULL,
                                    0L, 0, ID_RESOURCE, &hwndClient) ;

    while (WinGetMsg (hab, &qmsg, NULLHANDLE, 0, 0))
        WinDispatchMsg (hab, &qmsg) ;

    WinDestroyWindow (hwndFrame) ;
    WinDestroyMsgQueue (hmq) ;
    WinTerminate (hab) ;
    return 0 ;
}

VOID Justify (HPS hps, PCHAR pText, PRECTL prcl, SHORT nAlign, SHORT nSpace)
{
    int iBreakCount, iSurplus ;
    PCHAR pStart, pEnd ;
    POINTL ptlStart, aptlTextBox [TXTBOX_COUNT] ;

    ptlStart.y = prcl->yTop ;

    do
        // until end of text
    {
        iBreakCount = 0 ;

        while (*pText == ' ') // Skip over leading blanks
            pText++ ;

        pStart = pText ;

        do
            // until line is known
        {
            while (*pText == ' ') // Skip over leading blanks
                pText++ ;

            // Find next break point

            while (*pText != '\x0D' && *pText != ' ')
                pText++ ;

            // Determine text width

            GpiQueryTextBox (hps, pText - pStart, pStart,
                            TXTBOX_COUNT, aptlTextBox) ;

            // Normal case: text less wide than column

            if (aptlTextBox[TXTBOX_CONCAT].x < (prcl->xRight - prcl->xLeft))
            {
                iBreakCount++ ;
                pEnd = pText ;
            }

            // Text wider than window with only one word

            else if (iBreakCount == 0)
            {
                pEnd = pText ;
                break ;
            }

            // Text wider than window, so fix up and get out
        } else
    }

```

```

        {
            iBreakCount-- ;
            pText = pEnd ;
            break ;
        }

        while (*pText != '\x0D') ;

        // Get the final text box

        GpiQueryTextBox (hps, pEnd - pStart, pStart,
                        TXTBOX_COUNT, aptlTextBox) ;

        // Drop down by maximum ascender

        ptlStart.y -= aptlTextBox[TXTBOX_TOPLEFT].y ;

        // Find surplus space in text line

        iSurplus = prcl->xRight - prcl->xLeft -
                    aptlTextBox[TXTBOX_CONCAT].x ;

        // Adjust starting position and
        // space and character spacing

        switch (nAlign)
        {
            case IDM_LEFT:
                ptlStart.x = prcl->xLeft ;
                break ;

            case IDM_RIGHT:
                ptlStart.x = prcl->xLeft + iSurplus ;
                break ;

            case IDM_CENTER:
                ptlStart.x = prcl->xLeft + iSurplus / 2 ;
                break ;

            case IDM_JUST:
                ptlStart.x = prcl->xLeft ;

                if (*pText == '\x0D')
                    break ;

                if (iBreakCount > 0)
                    GpiSetCharBreakExtra (hps,
                                            65536 * iSurplus / iBreakCount) ;

                else if (pEnd - pStart - 1 > 0)
                    GpiSetCharExtra (hps,
                                      65536 * iSurplus / (pEnd - pStart - 1)) ;

                break ;
        }

        // Display the string & return to normal

        GpiCharStringAt (hps, &ptlStart, pEnd - pStart, pStart) ;
        GpiSetCharExtra (hps, 0) ;
        GpiSetCharBreakExtra (hps, 0) ;

        // Drop down by maximum descender

        ptlStart.y += aptlTextBox[TXTBOX_BOTTOMLEFT].y ;

        // Do additional line-spacing

        switch (nSpace)
        {
            case IDM_HALF:
                ptlStart.y -= (aptlTextBox[TXTBOX_TOPLEFT].y -
                               aptlTextBox[TXTBOX_BOTTOMLEFT].y) / 2 ;
                break ;

            case IDM_DOUBLE:
                ptlStart.y -= aptlTextBox[TXTBOX_TOPLEFT].y -
                               aptlTextBox[TXTBOX_BOTTOMLEFT].y ;
                break ;
        }

        while (*pText != '\x0D' && ptlStart.y > prcl->yBottom) ;
    }

MRESULT EXPENTRY ClientWndProc (HWND hwnd, ULONG msg, MPARAM mp1, MPARAM mp2)
{
    static HWND hwndMenu ;
    static PCHAR pText ;
    static RECTL rcl ;
    static SHORT nAlign = IDM_LEFT, nSpace = IDM_SINGLE ;
    HPS hps ;

    switch (msg)
    {
        case WM_CREATE:
            DosGetResource (0, IDT_TEXT, IDT_TWAIN, (PPVOID) &pText) ;

```

Figure 2: JUSTIFY.C contains all the source code for the JUSTIFY program.

JUSTIFY.C

2 of 2

```

        hwndMenu = WinWindowFromID (WinQueryWindow (
hwnd, QW_PARENT), FID_MENU) ;
        return 0 ;

    case WM_SIZE:
        WinQueryWindowRect (hwnd, &rc1) ;
        return 0 ;

    case WM_COMMAND:
        switch (COMMANDMSG(&msg)->cmd)
        {
            case IDM_RIGHT:
            case IDM_LEFT:
            case IDM_CENTER:
            case IDM_JUST:
                WinCheckMenuItem (hwndMenu, nAlign, FALSE) ;
                nAlign = COMMANDMSG(&msg)->cmd ;
                WinCheckMenuItem (hwndMenu, nAlign, TRUE) ;

                WinInvalidateRect (hwnd, NULL, FALSE) ;
                return 0 ;

            case IDM_SINGLE:
            case IDM_HALF:
            case IDM_DOUBLE:
                WinCheckMenuItem (hwndMenu, nSpace, FALSE) ;
                nSpace = COMMANDMSG(&msg)->cmd ;
                WinCheckMenuItem (hwndMenu, nSpace, TRUE) ;
        }

```

```

        WinInvalidateRect (hwnd, NULL, FALSE) ;
        return 0 ;
    }
    break ;

    case WM_PAINT:
        hps = WinBeginPaint (hwnd, NULLHANDLE, NULL) ;
        GpiErase (hps) ;

        CreateBitmapFont (hps, LCID_FONT, "Tms Rmn", 10, 0, 0) ;
        GpiSetCharSet (hps, LCID_FONT) ;

        Justify (hps, pText, &rc1, nAlign, nSpace) ;

        GpiSetCharSet (hps, LCID_DEFAULT) ;
        GpiDeleteSetId (hps, LCID_FONT) ;

        WinEndPaint (hps) ;
        return 0 ;

    case WM_DESTROY:
        DosFreeResource (pText) ;
        return 0 ;
    }
    return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
}

```

is shown in Figures 1 through 6.

Assuming you have the IBM C Developer's WorkSet/2 installed and the BMF bitmapped font files from the February 9, 1993, Environments column, you can create JUSTIFY.EXE by running:

```
NMAKE JUSTIFY.MAK
```

Or you can download all the source code and executable from the Programming Forum on PC MagNet archived as JUSTIF.ZIP.

The JUSTIFY.TXT file contains the sample paragraph used to illustrate paragraph formatting (it is the first paragraph of Mark Twain's *Adventures of Huckleberry Finn*). In the file, the paragraph is stored in ASCII as a single line of text followed by a carriage return (0x0D) and line feed (0x0A).

To keep the program down to a reasonable length, JUSTIFY is hard-coded to display the paragraph using an 18-point Tms Rmn font. The program displays the formatted paragraph using the

full width of the window. The menu has two options: The first is labeled Alignment and lets you pick left, right, centered, or justified. The second option is Spacing and lets you pick single spacing, 1.5 line-spacing, or double-spacing.

Figure 7 shows two instances of this program running under the OS/2 Presentation Manager. In both, single-spaced justified formatting has been chosen. The first instance shows the paragraph with a fairly normal width, and illustrates the text justification achieved by using GpiSetCharBreakExtra.

The second instance at the right of the screen has an extremely narrow column width, and several lines in the paragraph show what GpiSetCharExtra can do for you. The first three lines contain only one word with letters that are spread across the column. Further down, the word "Adventures" would normally be too wide to fit within the column, but GpiSetCharExtra caused the letters to be squeezed closer together.

THE JUSTIFY SOURCE CODE Before getting down to the actual paragraph-formatting code in the Justify function in JUSTIFY.C, let's first look at the ClientWndProc window procedure that accumulates all the information in preparation for calling Justify. During the WM_CREATE message, JUSTIFY calls DosGetResource to load in the text paragraph, which is listed as a user-defined resource in JUSTIFY.RC. A pointer to

JUSTIFY.RC

Complete Listing

```

/*-----
JUSTIFY.RC resource script file
-----*/

#include <os2.h>
#include "justify.h"

RESOURCE IDT_TEXT IDT_TWAIN justify.txt

MENU ID_RESOURCE
{
    SUBMENU "Alignment",          IDM_ALIGN
    {
        MENUITEM "Left",          IDM_LEFT,, MIA_CHECKED
        MENUITEM "Right",         IDM_RIGHT
        MENUITEM "Centered",      IDM_CENTER
        MENUITEM "Justified",     IDM_JUST
    }
    SUBMENU "Spacing",           IDM_SPACE
    {
        MENUITEM "Single",        IDM_SINGLE,, MIA_CHECKED
        MENUITEM "1.5 Lines",     IDM_HALF
        MENUITEM "Double",       IDM_DOUBLE
    }
}

```



Figure 3: JUSTIFY.RC is the program's resource script.

JUSTIFY.TXT

Complete Listing

You don't know about me, without you have read a book by the name of "The Adventures of Tom Sawyer," but that ain't no matter. That book was made by Mr. Mark Twain, and he told the truth, mainly. There was things which he stretched, but mainly he told the truth. That is nothing. I never seen anybody but lied, one time or another, without it was Aunt Polly, or the widow, or maybe Mary. Aunt Polly - Tom's Aunt Polly, she is - and Mary, and the Widow Douglas, is all told about in that book - which is mostly a true book; with some stretchers, as I said before.

Figure 4: JUSTIFY.TXT contains a sample paragraph stored in ASCII as a single line of text followed by a carriage return (0x0D) and line feed (0x0A).

the paragraph is stored in the variable pText. Later on, during the WM_DESTROY message, the resource is freed.

JUSTIFY's window procedure processes the WM_SIZE message by calling WinQueryWindowRect to obtain the client window rectangle. This is the rectangle in which the text will be displayed. During the WM_COMMAND message that indicates menu selections made by the user, JUSTIFY stores the current requested alignment in nAlign and the current requested line spacing in nSpace.

Finally, during the WM_PAINT message, the program obtains a presentation space handle and selects an 18-point Tms Rmn font by calling CreateBitmapFont (one of the functions in BMF.C) and GpiSetCharSet. At this time, the program has everything it needs to display the paragraph, which it does with a call to the Justify function.

Justify begins by initializing the y field of the POINTL structure, named ptlStart, to the top of the display rectangle. This structure will later be used to indicate the starting position of each line

of text. The code in the main do loop is executed once per line. The iBreakCount variable is used to store the number of break characters (spaces) in the line and is initialized to 0. After skipping over any leading spaces in the text pointed to by the pText variable, the function saves the pointer value in pStart, indicating the beginning of the text line.

The nested do loop is executed for each word in the line. Again, the function skips over any leading spaces pointed to by pText, and then searches for either a space (indicating the end of a word) or the concluding carriage-return character. GpiQueryTextBox is used to determine the length of the string. There are three cases: If the text width is less than the column width, then iBreakCount is incremented and the pEnd pointer is set to the end of the substring. If a single word is wider than the column, the pEnd is also set to the end of the substring and the function breaks out of the do loop. Otherwise, a series of two or more words is wider than the column. That means the substring contains one too many words. The iBreakCount variable is decremented and pText is set to the previously set pEnd in preparation for scanning the next line of text.

The Justify function then calls GpiQueryTextBox again to get the dimensions of the final text box for the line. The y field of the ptlStart structure is decremented to reflect the ascender part of the character height. The surplus space is calculated by subtracting the text width from the column width. At this point, the function is ready to set the x field of

ptlStart depending on the selected alignment. For left justification, it's simply the left side of the rectangle. For right justification, it's the left side of the rectangle plus the surplus space. For centered text, it's the left side of the rectangle plus half the surplus space.

For justified text, the text string also begins at the left side of the rectangle. For a positive iBreakCount, the function calls GpiSetCharBreakExtra as described earlier. Otherwise, the line contains one

JUSTIFY.DEF

Complete Listing

```

;-----
; JUSTIFY.DEF module definition file
;-----

NAME                JUSTIFY    WINDOWAPI

DESCRIPTION          'Justify Bitmap Fonts (c)
Charles Petzold, 1993'
PROTMODE

```



Figure 6: JUSTIFY.DEF is the program's module-definition file.

JUSTIFY.H

Complete Listing

```

/*-----
JUSTIFY.H header file
-----*/

#define ID_RESOURCE    1

#define IDT_TEXT       1024
#define IDT_TWAIN      1

#define IDM_ALIGN      10
#define IDM_LEFT       11
#define IDM_RIGHT      12
#define IDM_CENTER     13
#define IDM_JUST       14

#define IDM_SPACE      20
#define IDM_SINGLE     21
#define IDM_HALF       22
#define IDM_DOUBLE     23

```



Figure 5: JUSTIFY.H defines constants used in the C program and resource script.

word and the function calls GpiSetCharExtra. At this time Justify can display the line of text by calling GpiCharStringAt. The function then uses the height of the font and the selected line-spacing to decrease the y field of the ptlStart structure in preparation for the next line.

DEALING WITH COMPLEXITY For clarity, Justify illustrates what is perhaps the simplest paragraph-formatting code. If the paragraph contains any words with character formatting (italics, boldface, underlines, or strike-outs), then the function is not quite adequate.

The combination of paragraph formatting and character formatting adds complexities, but not insurmountable ones. Basically, as you scan the paragraph looking for line breaks, you have to select different fonts based on the various character attributes. You can't use GpiQueryTextBox to find the total length of the

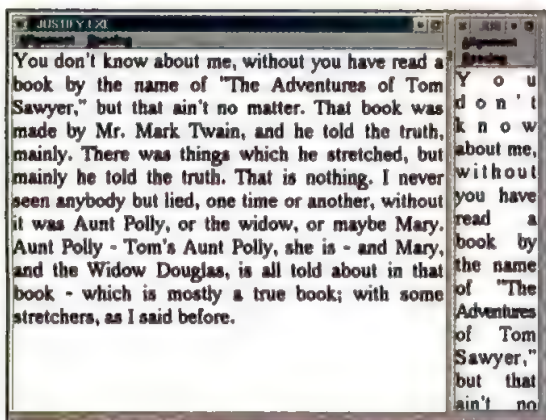


Figure 7: Two instances of JUSTIFY running under the OS/2 PM.

string because the function is based on the font currently selected in the presentation space. You'll have to break the text down into pieces depending on which words (or letters) are formatted and which ones aren't.

If you want to display some words in color, you don't have exactly the same problems. You must still display the text in pieces, but because text color is an attribute of the presentation space instead of part of the font definition, you can still determine line breaks as shown in the Justify function.

Another complexity involves hyphens. There are actually several different ways in which hyphens must be treated. Compound words such as "freelance" contain a hyphen that should appear whenever the word is displayed. If the "free-" part of the word fits on the line but the "lance" part does not, then the line can break between the two parts. Thus, you can treat the hyphen almost the same as a space character, except that a space character doesn't appear at the beginning or end of a line while the hyphen must appear at the end of the line.

Then there's the notorious "no break" hyphen. These appear in words such as "A-1." This would look very strange if "A-" appeared at the end of one line and "1" appeared at the beginning of the next. In this case, you want all 3 characters to appear on the same line.

Long words can be broken at the end of a line using a hyphen between syllables. The hyphen should not appear otherwise. These hyphens can be inserted during text display using a dictionary or

a good hyphenation algorithm, or the user can insert them manually.

The hyphen problem gets worse: Although the *Huckleberry Finn* paragraph shown in Figure 7 seems to contain a few hyphens, I'm not using them correctly. Hyphens should be used in words such as "freelance," but to separate a phrase in a sentence—such as this one right here—an en dash or em dash should be used instead. An en dash is half the width of an em dash, which is as wide as

the point size of the font. The en dash is also used in place of the word "to," such as when referring to "the Boston-New York shuttle."

WAIT—THERE'S MORE There are still a few text functions I haven't discussed. These allow a high level of control over the placement of characters in a string and also determine where the characters appear.

The `GpiQueryCharStringPos` and `GpiQueryCharStringPosAt` functions fill an array of `POINTL` structures with the starting positions of all the characters in a text string. These functions are useful for implementing *hit-testing*—that is, determining which character in a displayed string a user is clicking with the mouse.

If you're so inclined, you can do precise character-by-character positioning of a text string using the `GpiCharStringPos` and `GpiCharStringPosAt` functions. However, unless you want irregular character spacing, then the `GpiSetCharExtra` and `GpiSetCharBreakExtra` functions are much easier to use.

The `GpiQueryWidthTable` function gives you the width of any (or all) of the characters in the current font, and `GpiQueryKerningPairs` gives you all the kerning pairs. These are pairs of letters (such as *To*) that can be placed somewhat closer than normal to look a little better. The bitmapped fonts do not support kerning. Although we've found many things we can do with bitmapped fonts, we've also discovered things we cannot do. For that reason, next time we'll start looking at the Adobe Type 1 outline fonts supported under OS/2. Now it's time to really party. □

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Dissecting Resources in Windows NT Executable Files

BY RAY DUNCAN

In the last installment of this column, I introduced you to Windows NT's so-called *portable executable* (PE) file format for 32-bit protected-mode programs. As you'll recall, the PE format is a superset of the Common Object File Format (COFF) used in Unix System 5, along with some elements that are derived from MS-DOS real-mode (MZ) executable files and Windows 3.1 (NE) segmented executables. I also showed you how we could, in spite of minimal documentation from Microsoft, use what we know of COFF to dissect a small Windows NT executable into its components, and then use some common sense and educated guesswork to write routines that decode and display a program's table of imported functions.

In this installment, we'll play the PE dissection game again, only this time we'll go after a more interesting and considerably more complex target: the resource section of a Windows NT executable. You'll probably find it helpful to have the diagrams that were printed in my column in the previous issue of *PC Magazine* handy as you follow this discussion.

THE WHAT AND WHY OF RESOURCES The general concept of program resources, like most everything else in GUI programming, probably dates back somehow to the work at Xerox's Palo Alto Research Center (PARC) in the 1970s. However, again like most everything else in GUI programming, the concept of resources was first popularized in the executable file format for the Apple Macintosh. *Resources* are essentially static binary representations of various user interface objects—such as dialogs, menus, icons, cursors, and text strings—that are stored in the executable file as discrete

objects separate from the program's code and data. When the program is executing and needs to present one of these resources to the user, it references the resource by name or ID number and calls a special operating system function to load the resource into memory from its own executable file. It can then manipulate the resource directly or call another operating system function to display the resource on the screen.

There are some important advantages to encapsulating user interface objects as

with the program code to create a country-specific version of the application. If the program is carefully designed, a new language version can even be derived from an existing version "in the field" with the aid of a translator and a resource editor.

- A virtual memory operating system can treat resources as read-only static data objects, discarding them from memory when memory resources are low, and demand-loading them again from the executable file whenever it is necessary to do so.

If you have a program like Borland's Resource Workshop under Windows or ResEdit on the Macintosh, you can learn quite a bit (and have some fun besides) by poking around in the executable files for the operating system and your favorite application programs. You can customize the appearance of programs to suit yourself, "borrow" icons to serve as the basis of your own designs, or even change the wording of error messages. Of course, such twiddling should always be done on a copy of the original working program, so that you have a reasonable fall-back position if something goes wrong!

WINDOWS AND WINDOWS NT RESOURCES

From the end user's point of view, the user interface objects of Windows 3.1 and Windows NT are essentially identical and work the same way: menus, dialogs, icons, cursors, bitmaps, fonts, strings, and accelerator keys. This is not exactly a happy accident; the designers of Windows NT had as major goals the preservation of the already proven (and already popular) look-and-feel of Windows as well as the ability to run existing Windows 3.1 programs. However, the processing and binary representation of resources within Windows 3.1 NE files and Windows NT PE files differ from one an-

resources in this way:

- Resources can be designed, compiled, and tested independently from the program's logic. In many cases, resources can even be extracted from the executable file, improved, and poked back into the executable file without recompiling the program (for example, to change the arrangement of buttons in a dialog box). Conversely, bugs in the program's logic can usually be fixed without concern for accidentally breaking part of the user interface.
- Internationalization of programs can be facilitated by maintaining several sets of resources for different languages in parallel, and merging one particular set

*We continue our
examination of Windows
NT executable files with
the goal of understanding
how resources are
implemented and how they
can be manipulated.*

Elements of the Resource Directory

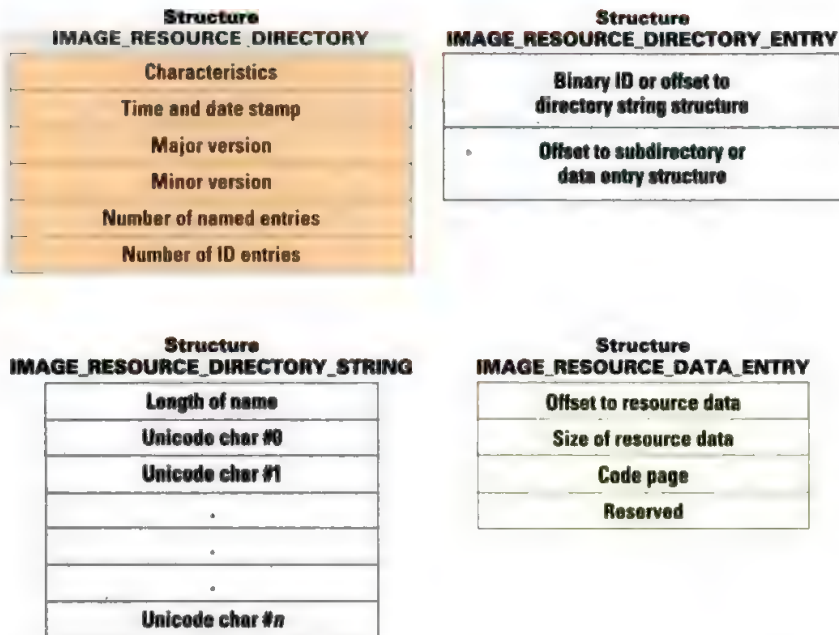


Figure 1: This diagram shows the fields in each of four resource structures found in a Windows NT portable executable (PE) file.

A Sample Hierarchical Resource Directory

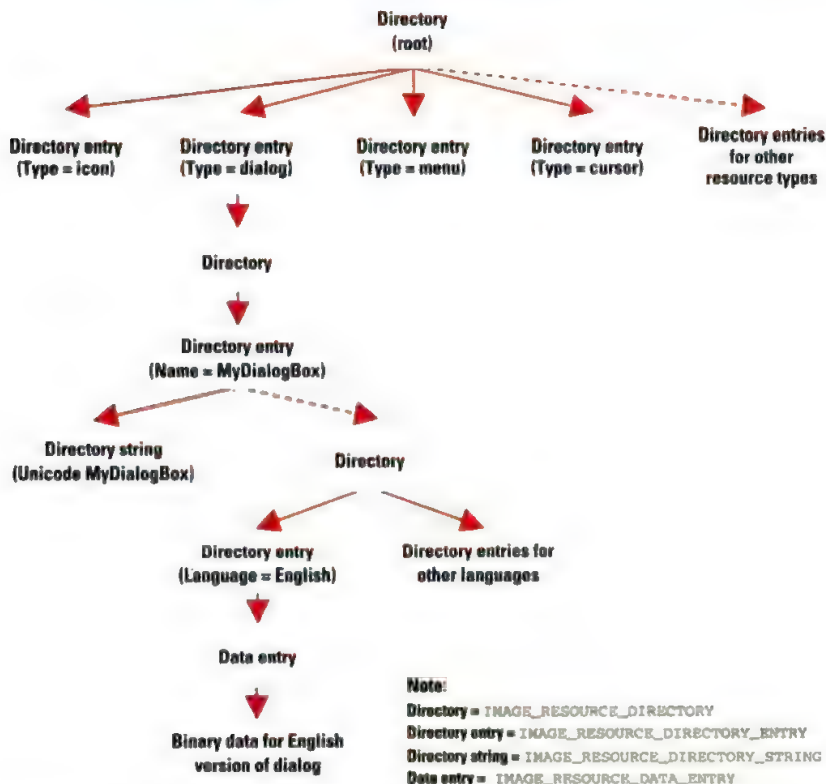


Figure 2: Using WINAPP.EXE as an example, we can see the logical structure of a resource directory in a Windows NT portable executable file.

other in some important ways.

- The binary encoding of Windows NT resources is different from Windows 3.1 to allow for 32-bit values and pointers, although the internal structure of dialogs and menus is still recognizable.
- Strings in Windows 3.1 resources use the so-called ANSI character set, which is a mutant of the original ASCII character set. Text in Windows NT resources is encoded in the Unicode 16-bit character set.
- The resources in a Windows 3.1 executable file are found by linear search of a directory, called the *resource table*, located behind the file header. The actual binary resources are each stored in a Windows 3.1 file as a separate segment. In Windows NT, the resource directory is structured as a binary tree, and the resource directory and the resources themselves are combined into a single COFF file section named .rsrc.
- Resources are merged into a Windows 3.1 executable file by the Resource Compiler, which works completely independently of the system linker. In Windows NT, the Resource Compiler produces a COFF object which is then fed to the system linker along with the object modules for program code and data to build the executable file.

Interestingly, the creation of resource manipulation tools under Windows NT by third-party vendors, such as the Borland Resource Workshop, has been made considerably easier by some new functions in the WIN32 API. The function EnumResourceTypes() can be used to build a list of the resource types within a given executable file; the function EnumResourceNames() delivers the names of all the resources of a given type within a file; and the function EnumResourceLanguages() obtains internationalization information for a specific resource. The function BeginUpdateResource() returns a handle to a resource within an executable file; the function UpdateResource() can be used with the handle to add, delete, or replace the resource in the file; and the function EndUpdateResource() closes the resource handle.

SOLVING THE RESOURCE PUZZLE It's dandy that Microsoft has (finally) given us an API for direct manipulation of bi-



Figure 3: The EXELOOK program in action, showing the list of resources in the executable file for the WINAPP application.

nary resources, but it doesn't further our original goal of understanding the deep structure of a Windows NT PE executable. So let's return to first principles, create a small program with a sampling of the most popular resource types, inspect the executable file's contents, and see what we can learn. As it happens, we already have an almost ideal program in hand for this purpose, the WINAPP skeleton application published in this column in the October 13, 1992, issue. WINAPP.EXE contains a menu resource named WINAPPMENU, an icon named WINAPPICON, and a dialog box named ABOUTBOX.

In order to start working with the resource section of the WINAPP.EXE file, we must first apply the knowledge that we gained last time. We first look in the last four bytes of the real-mode (MZ) file header to find the offset of the portable executable (PE) file header, jump just past the PE signature to get to the COFF file header, use the data in the COFF file header to skip over the COFF optional header, and arrive finally at the COFF section headers. Recall that each section header provides vital information about one of the sections that makes up the remainder of the executable file: the section's name as an ASCII string, the section's size, the offset to the section's raw data within the file, the section's characteristics (code, data, read-only, and so on), and the virtual address at which the section will be mapped by the

these. We know from our earlier explorations that the .idata section is the program's table of imported modules and functions, and the .reloc and .debug sections are pretty obviously not what we're looking for. The .rdata and .CRT sections can be put aside as mysteries to be solved at a later time, leaving us with the section named .rsrc. One doesn't need to be a detective to surmise that .rsrc stands for resources!

Sure enough, when we look at the hex dump of the portion of the file at the offset given in the .rsrc section header for the section's raw data, we find a mish-mash of binary data followed by some very spread-out-looking strings corresponding to the expected contents of the ABOUTBOX dialog. The strings are bulky, compared to what we are used to seeing in hex dumps of an MS-DOS or OS/2 file, because each character of a Unicode string occupies 16-bits. Unicode is a sort of universal character set that contains codes for all of the glyphs in all the world's alphabets, and the Unicode support in Windows NT will pro-

operating system loader.

In the case of the WINAPP.EXE file, we discover nine section headers containing the following names: .text, .bss, .data, .rdata, .idata, .rsrc, .CRT, .reloc, and .debug. The sections .text, .bss, and .data are standard COFF names for a program's machine code, uninitialized data, and initialized data, respectively, so we can bypass

vide fodder for many future columns. For our purposes here, suffice it to say that the Unicode committee was nice enough to map the 8-bit ASCII codes into the 16-bit character space by simply extending them with zero bits.

In order to decode the binary data at the start of the resource section, we can turn for help to the NTIMAGE.H file that is supplied in the MSTOOLSHV\ directory of the Windows NT Software Development Kit. This file contains structure and constant declarations for many of the elements and flags found in a Windows NT PE file, along with documentation in the form of program comments that has varying levels of accuracy and usefulness. In particular, the NTIMAGE.H file contains TYPEDEFS for four structures that are apparently related to resources:

```
IMAGE_RESOURCE_DIRECTORY
IMAGE_RESOURCE_DIRECTORY_ENTRY
IMAGE_RESOURCE_DIRECTORY_STRING
IMAGE_RESOURCE_DATA_ENTRY
```

The fields in these four different types of structures are sketched in Figure 1. Marking up the hex dump of the .rsrc section of the file with a pencil, we soon find that the binary data at the start of the section, which seems at first glance to be a simple table, is actually a highly structured directory to the resources in the section. It falls apart into various numbers of these four types of structures, linked together from an initial instance of an

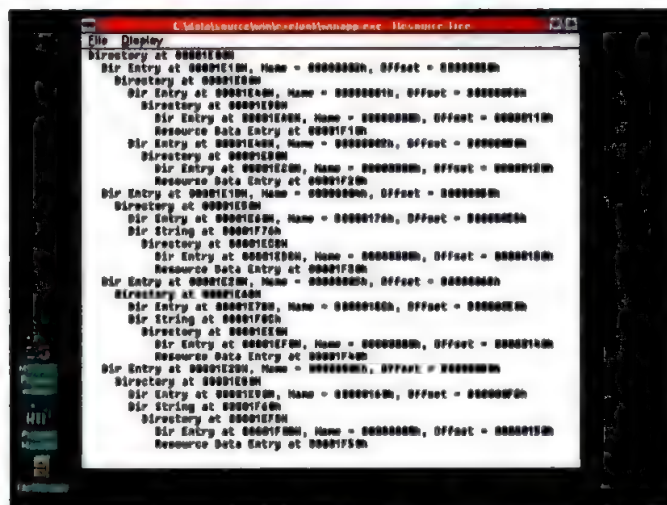


Figure 4: The EXELOOK program in action, showing the structure of the hierarchical resource directory in the WINAPP.EXE file.

IMAGE_RESOURCE_DIRECTORY structure and apparently organized as a tree, and the offsets in the various instances of the IMAGE_RESOURCE_DATA_ENTRY structures point farther into the .rsrc section to recognizable binary data for the resources that we know have to be present. So far, so good.

But there's still something perplexing about the resource directory tree, as you'll soon see if you go through this exercise with the WINAPP.EXE file for yourself. First, the tree seems to have a great many redundant structures. Directories point to directory entries, which point to directories, which point to more directory entries, which ultimately point to a data entry, which in turn points to the actual resource. For example, there are eight levels of indirection from the section header to the binary data for WINAPP's icon resource! This seems excessively baroque, even for an operating system as complex as Windows NT. Second, it isn't immediately obvious, from the information in the NTIMAGE.H file or from direct inspection of the resource data, where the resource type informa-

tion is encoded, even though it absolutely has to be buried in there someplace. Third, there seem to be collisions between resource IDs in the directory tree, even though we are confident this can't happen in practice.

*The resource directory
or resource table is not
really a tree at all, and
certainly not a binary tree,
but rather a hierarchical
directory structure with
exactly three levels.*

My own confusion over the resource directory structure was finally resolved with the aid of the following comment in the RESFMT.DOC file that I downloaded from the Microsoft-hosted Windows NT support conference on Compu-

Serve: "The [resource] table contains two or three directories, indexed by Type, Name, and Language, in that order. The Language directory is optional." I must admit that this statement blew right by me the first couple of times I read it, mainly because the .DOC file as a whole is discussing the formats of the binary resources themselves and only mentions the final executable file in passing. Eventually, though, the light dawned, and the essential niftiness of the organization of an NT executable's resource directory became evident even to me.

In brief, the resource directory or resource table is not really a tree at all, and certainly not a binary tree as claimed in another part of the RESFMT.DOC file, but rather a hierarchical directory structure with exactly three levels. The Name field of an IMAGE_RESOURCE_DIRECTORY_ENTRY structure, which is documented in the NT-IMAGE.H file to contain either a binary resource ID or an offset to a structure containing the resource's name, actually serves different purposes depending on which level of the hierarchical resource

EXELOOK Routines for the Resource List

1 of 2

```
// Extracts from EXELOOK.C
// Routines related to display of simple resource list
// Copyright (C) 1992 Ray Duncan
// PC Magazine © Ziff Davis Publishing

#define dim(x) (sizeof(x) / sizeof(x[0])) // returns no. of elements

PSCNHEADER pRsrcHeader; // addr resource section header
PRSRCDIR pRsrcDirectory; // addr resource directory
int iTreeLevel = 0; // nesting level of tree
char RsrcName[256]; // name of current resource
PSTR pRsrcType; // name of current type
PSTR pMap = NULL; // base address file mapping

struct decodeUINT RsrcType[] = { // structure relates
    RSRC_CURSOR, "Cursor", // binary resource code
    RSRC_BITMAP, "Bitmap", // to descriptive string
    RSRC_ICON, "Icon",
    RSRC_MENU, "Menu",
    RSRC_DIALOG, "Dialog",
    RSRC_STRING, "String",
    RSRC_FONTDIR, "Font Dir",
    RSRC_FONT, "Font",
    RSRC_ACCELERATOR, "Accelerators",
    RSRC_RCDATA, "User Defined",
    RSRC_MESSAGE_TABLE, "Message Table",
    RSRC_GROUP_CURSOR, "Cursor Group",
    RSRC_GROUP_ICON, "Icon Group",
    RSRC_VERSION, "Version",
    RSRC_DIALOG_INCLUDE, "Dlg Include",
    RSRC_NEW_BITMAP, "New Bitmap",
    RSRC_NEW_MENU, "New Menu",
    RSRC_NEW_DIALOG, "New Dialog" };

.
.
.
various routines omitted here
.
.
//
```

```
// ShowResources - formats names or IDs, types, addresses, and sizes
// of binary resources (icons, dialogs, menus, bitmaps, and so on).
//
VOID ShowResources(VOID)
{
    char temp[256];

    if(pRsrcDirectory == NULL) // bail if no resource section
    {
        PostMessage(hFrame, WM_COMMAND, IDM_SECT, 0);
        return;
    }

    // format title line with spacing to match detail lines
    wsprintf(temp, "%12s %14s %9s %9s %9s %9s",
        "Resource Name or ID", "Type", "Virt Addr",
        "File Addr", "Size", "Code Page");
    AddLine(temp);

    iTreeLevel = 0; // reset nesting level
    ShowRsrcDir(pRsrcDirectory); // start with root directory
}

//
// ShowRsrcDir - traverse directory entries for the specified
// resource directory. Gets called by its own subroutines to
// walk recursively through the entire resource directory tree.
//
VOID ShowRsrcDir(PRSRCDIR pCurRsrcDir)
{
    PRSRCDIRENTRY pCurDirEntry;
    UINT i, j;

    // calculate address of first entry for this directory
    pCurDirEntry = (PRSRCDIRENTRY) ((PBYTE) pCurRsrcDir +
        sizeof(IMAGE_RESOURCE_DIRECTORY));

    // find number of entries (by ID or by name)
    j = max(pCurRsrcDir->NumberOfNamedEntries, pCurRsrcDir->NumberOfIdEntries);
```

Figure 5: Extracts from the source code for the EXELOOK program, showing the routines responsible for the resource list shown in Figure 3.

EXELOOK Routines for the Resource List

2 of 2

```

// now go and process each entry
for(i = 0; i < j; i++)
{
    ShowRsrcDirEntry(pCurDirEntry);
    pCurDirEntry++;
}

//
// ShowRsrcDirEntry - process one directory entry. If at directory
// level zero, the name field indicates the type of resource. If at
// directory level one, the name field indicates the ID or name of
// a single discrete resource. If at directory level two, the name
// indicates the language (not handled by this code as we have no
// working examples of multilanguage files yet).
//
VOID ShowRsrcDirEntry(PRSRCDIRENTRY pCurDirEntry)
{
    PRSRCDIRSTR pCurDirString;
    PRSRCDATAENTRY pCurDataEntry;
    int i;

    // If this is first level of directory, the name field of the
    // directory entry indicates the resource type. Find the string
    // corresponding to the resource type, save its address for later.
    if(iTreeLevel == 0)
    {
        pRsrcType = "Unknown";

        for(i = 0; i < dim(RsrcType); i++)
        {
            if(RsrcType[i].Code == pCurDirEntry->Name)
                pRsrcType = RsrcType[i].Name;
        }

        // Now format the resource name or ID. If we happen to be at
        // directory level zero no harm is done, the resulting string will
        // just get overwritten during processing of next level.
        if(pCurDirEntry->Name & IMAGE_RESOURCE_NAME_IS_STRING)
        {
            // calculate file address of UNICODE resource name
            pCurDirString = (PRSRCDIRSTR) ((PBYTE) pRsrcDirectory +
                (pCurDirEntry->Name &
                ~IMAGE_RESOURCE_NAME_IS_STRING));
        }
    }
}

```

```

// convert UNICODE resource name to ASCIIZ for later display
memset(RsrcName, 0, sizeof(RsrcName));
wcstombs(RsrcName, (LPWSTR) pCurDirString->NameString,
    pCurDirString->Length);
}
else if(pCurDirEntry->Name) // format ID if nonzero
{
    wprintf(RsrcName, "%08Xh", pCurDirEntry->Name);
}

// calculate address of resource data entry for this directory entry
pCurDataEntry = (PRSRCDATAENTRY) ((PBYTE) pRsrcDirectory +
    (pCurDirEntry->OffsetToData &
    ~IMAGE_RESOURCE_DATA_IS_DIRECTORY));

// if data field of entry points to a resource subdirectory,
// call ShowRsrcDir to process the subdirectory, otherwise, call
// ShowRsrcDataEntry to format the resource information.
if(pCurDirEntry->OffsetToData & IMAGE_RESOURCE_DATA_IS_DIRECTORY)
{
    iTreeLevel++; // update nesting level
    ShowRsrcDir((PRSRCDIR) pCurDataEntry); // audit subdirectory
    iTreeLevel--; // update nesting level
}
else ShowRsrcDataEntry(pCurDataEntry); // audit resource data entry
}

//
// ShowRsrcDataEntry - formats and displays the name, type, address,
// size, and code page of a discrete binary resource, using information
// in the data entry structure and the resource ID or name and resource
// type saved during traversal of the directory tree.
//
VOID ShowRsrcDataEntry(PRSRCDATAENTRY pCurDataEntry)
{
    char temp[256];

    wprintf(temp, "%-24s %-14s %08Xh %08Xh %08Xh %08Xh",
        RsrcName, // resource name or ID
        pRsrcType, // resource type
        pCurDataEntry->OffsetToData, // virtual address of resource
        pCurDataEntry->OffsetToData - // file offset of resource
        pRsrcHeader->VirtualAddress + pRsrcHeader->PointerToRawData,
        pCurDataEntry->Size, // resource size
        pCurDataEntry->CodePage); // resource code page
    AddLine(temp);
}

```

EXELOOK Routines for the Resource Directory

1 of 2

```

// Extracts from EXELOOK.C
// Routines related to display of resource directory tree
// Copyright (C) 1993 Ray Duncan
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// macro to convert mapped memory address to file offset
#define FileOffset(x) ((ULONG) x - (ULONG) pMap)

char Spaces[256]; // holds string of blanks
PSCNHEADER pRsrcHeader; // addr resource section header
PRSRCDIR pRsrcDirectory; // addr resource directory
int iTreeLevel = 0; // nesting level of tree
PSTR pMap = NULL; // base address file mapping

.
.
.
various routines omitted here
.
.

//
// ShowResourceTree -- formats and displays a tree-like listing of
// all resource directories, directory entries, and data entries
//
VOID ShowResourceTree(VOID)
{
    if(pRsrcDirectory == NULL) // bail if no resource section
    {
        PostMessage(hFrame, WM_COMMAND, IDM_SECT, 0);
        return;
    }

    iTreeLevel = 0; // reset tree indent level
}

```

```

ShowRsrcTreeDir(pRsrcDirectory); // start with root directory
}

//
// ShowRsrcTreeDir -- audit a resource directory and all its dependent
// data structures. Called recursively to walk through the resource
// directory tree.
//
VOID ShowRsrcTreeDir(PRSRCDIR pCurRsrcDir)
{
    PRSRCDIRENTRY pCurDirEntry;
    UINT i, j;
    char temp[256];

    // display file offset of this directory
    wprintf(temp, "%sDirectory at %08Xh", Spaces, FileOffset(pCurRsrcDir));
    AddLine(temp);

    // calculate address of first entry for this directory
    pCurDirEntry = (PRSRCDIRENTRY) ((PBYTE) pCurRsrcDir +
        sizeof(IMAGE_RESOURCE_DIRECTORY));

    // find number of entries (either by ID or by name)
    j = max(pCurRsrcDir->NumberOfNamedEntries, pCurRsrcDir->NumberOfIdEntries);

    for(i = 0; i < j; i++)
    {
        // audit each entry for this directory
        ShowRsrcTreeDirEntry(pCurDirEntry);
        pCurDirEntry++;
    }
}

```



Figure 6: Extracts from the source code for the EXELOOK program, showing the routines responsible for the resource directory tree shown in Figure 4.

EXELOOK Routines for the Resource Directory

2 of 2

```

)

//
// ShowRsrcTreeDirEntry -- formats and displays the contents of a
// resource directory entry. If the directory entry's name
// field points to a resource directory string record containing
// a UNICODE resource name, also displays address of that record.
//
VOID ShowRsrcTreeDirEntry(PRSRCDIRENTRY pCurDirEntry)
{
    PRSRCDIRSTR pCurDirString;
    PRSRCDATAENTRY pCurDataEntry;
    char temp[256];

    // format information about current directory entry
    wprintf(temp, "%s Dir Entry at %08Xh, Name = %08Xh, Offset = %08Xh",
        Spaces, FileOffset(pCurDirEntry), pCurDirEntry->Name,
        pCurDirEntry->OffsetToData);
    AddLine(temp);

    // format address of directory string structure, if any
    if(pCurDirEntry->Name & IMAGE_RESOURCE_NAME_IS_STRING)
    {
        // calculate file address of UNICODE resource name
        pCurDirString = (PRSRCDIRSTR) ((PBYTE) pRsrcDirectory +
            (pCurDirEntry->Name &
            ~IMAGE_RESOURCE_NAME_IS_STRING));

        wprintf(temp, "%s Dir String at %08Xh", Spaces,
            FileOffset(pCurDirString));
        AddLine(temp);
    }

    // calculate address of resource data entry or subdirectory for
    // the current directory entry
    pCurDataEntry = (PRSRCDATAENTRY) ((PBYTE) pRsrcDirectory +
        (pCurDirEntry->OffsetToData &
        ~IMAGE_RESOURCE_DATA_IS_DIRECTORY));

    // if data field of entry points to a resource subdirectory,
    // call ShowRsrcTreeDir to audit the subdirectory, otherwise, call
    // ShowRsrcTreeDataEntry to format the resource data entry record.
    if(pCurDirEntry->OffsetToData & IMAGE_RESOURCE_DATA_IS_DIRECTORY)
    {
        SetSpaces(++iTreeLevel); // indent tree display
        ShowRsrcTreeDir((PRSRCDIR) pCurDataEntry); // audit subdirectory
        SetSpaces(--iTreeLevel); // outdent tree display
    }
    else
        ShowRsrcTreeDataEntry(pCurDataEntry); // audit resource data entry
}

//
// ShowRsrcTreeDataEntry -- formats and displays the contents of a
// resource data entry record within the resource section header.
//
VOID ShowRsrcTreeDataEntry(PRSRCDATAENTRY pCurDataEntry)
{
    char temp[256];

    wprintf(temp, "%s Resource Data Entry at %08Xh", Spaces,
        FileOffset(pCurDataEntry));
    AddLine(temp);
}

//
// SetSpaces -- creates an ASCII string of spaces whose length
// depends on the current resource directory tree nesting level.
//
VOID SetSpaces(INT iSpaces)
{
    memset(Spaces, 0, sizeof(Spaces));
    memset(Spaces, ' ', iSpaces*4);
}

```

directory you are looking at. At the first level of the hierarchy, the Name field of an IMAGE_RESOURCE_DIRECTORY_ENTRY structure contains a binary code for the resource type: 1 for cursors, 2 for bitmaps, 3 for icons, and so on. (Constants for the resource types are declared in one of the SDK header files with names of the form RT_xxxx, for example, RT_ICON.)

At the second level of the resource directory hierarchy, the Name field of a directory entry contains exactly what it purports to contain, the binary ID of a resource or a pointer to a structure containing the resource's name. In the third level of the hierarchy, presumably, the Name field of a directory entry contains some sort of code for the language used in the resource. We are not able to test this assumption at present, though, because Unicode support in Windows NT is still evolving, and we don't have any multilanguage applications to work with. The Name fields in all the third-level IMAGE_RESOURCE_DIRECTORY_ENTRY structures I've looked at so far contain a zero. Figure 2 shows a sketch of the hierarchical resource di-

rectory for WINAPP.EXE, which may help make things a little bit easier to understand.

THE EXELOOK PROGRAM At this point we have enough information to expand the EXELOOK program (introduced in the last installment of this column) in order to decode the resource information in a Windows NT executable file. Figure 3 shows the EXELOOK program's simple listing of resources in the WINAPP.EXE file, and Figure 4 shows EXELOOK's representation of the hierarchical resource directory in the same WINAPP.EXE file. (EXELOOK is also able to display information from the COFF file headers, section headers, import table, and export table, depending on which item you pick from EXELOOK's Display pop-up menu.)

Figure 5 contains an extract of the EXELOOK source code related to production of the simple resource list for a Windows NT executable file, and Figure 6 contains the source code related to display of the hierarchical resource directory. The full source code for the EXELOOK program, along with the necessary resource files, header files,

make files, and the executable utility can be downloaded from the Programming Forum on PC MagNet archived as EXELOOK.ZIP.

Why mess around with this resource bit-banging at all, when the WIN32 API provides an easier, safer way to do exactly the same thing? Well, one reason is simply to understand what's going on in the executable file: why the supplied WIN32 API for resources is the way it is, and (by inference) how the system loader relates to an executable file. Additionally, one might want to write programming tools that manipulate the resources located in Windows NT executables while running under a (currently) more stable development environment such as OS/2, or DOS and Windows. Lastly, it's an interesting project that can yield tangible results and, like Mount Everest, simply "because it's there."

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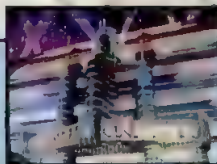
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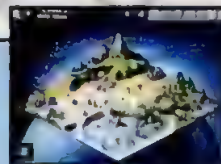


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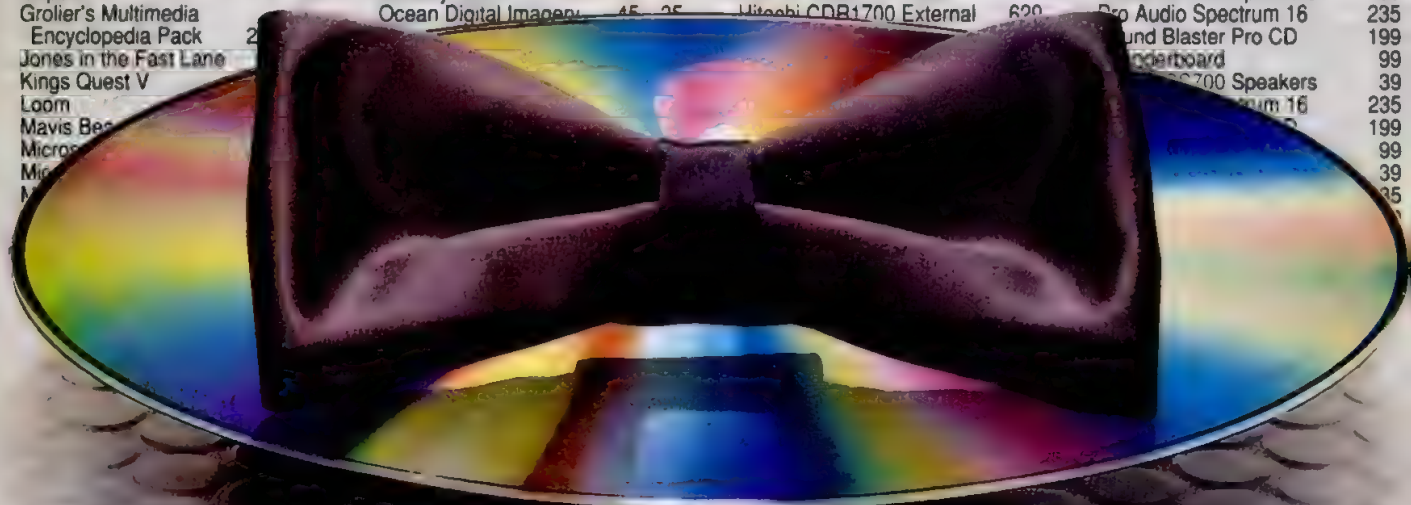
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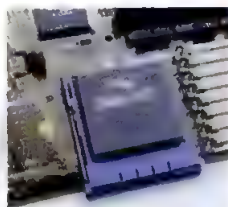
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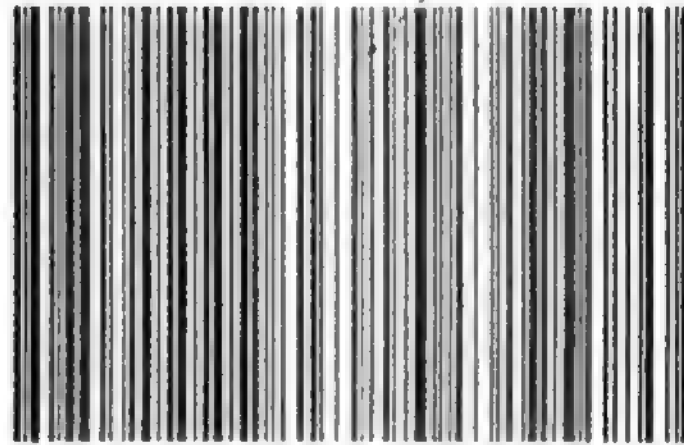


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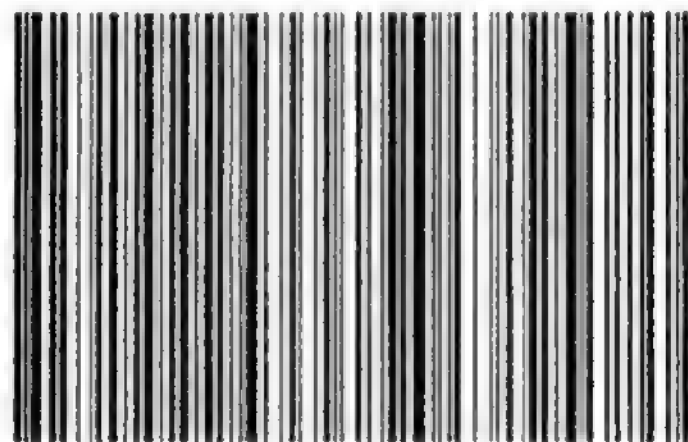
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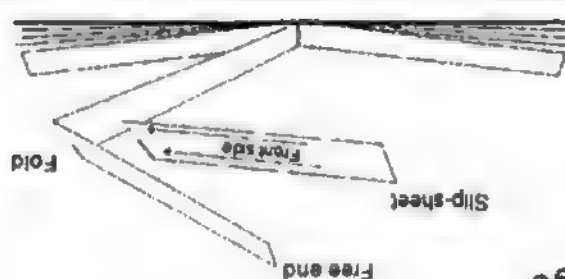
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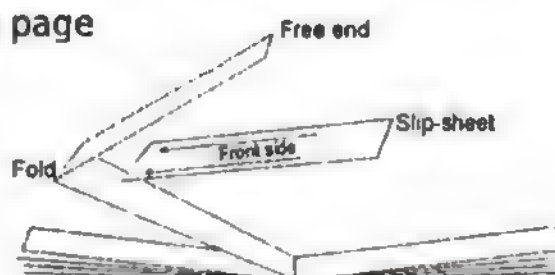
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Personal Purchases
Insight Credit Card

System cost:	Monthly Payments (1):
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\$2,500	\$125
\$5,000	\$250

LEASING

Business Purchases
Insight Leasing

System cost:	Monthly Payments (2)
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\$2,500	\$122
\$5,000	\$223
\$5,000(3)	\$208

(1) Insight credit card payments are based on 24 equal monthly payments.

(2) The above figures are for illustration only and are subject to change without notice. Leasing payments are based on a 24 month fair market value lease. Applicable sales tax is not included in the payment figure. Leases are non-cancelable and may require a deposit.

(3) Based on zero percent interest. Offer only good thru March 31, 1993. All other conditions apply. (Zero percent interest only applies to leases greater than \$2,500.)

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Comparison based on sequential read tests performed on a 16-bit controller and the new VESA based IDE 32-bit controller.

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PC Sources, January 1993 "Buying into Local Bus"

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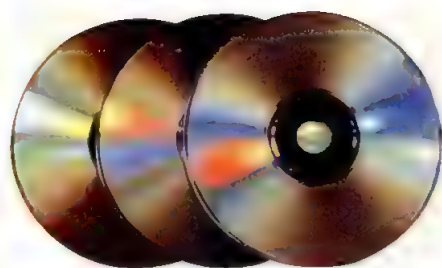


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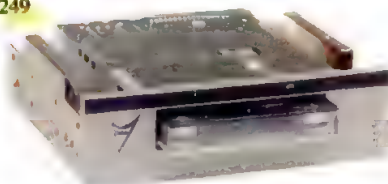
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Mamidkan Abdullakhan
Niamey, Niger

► **PC MAGAZINE:** Unfortunately, this is not uncommon. Fierce competition forces companies to live dangerously close to the edge, and many go out of business with little or no warning. Luckily, getting parts for orphaned computers isn't as difficult as it may seem.

A few notebook manufacturers (mainly in Taiwan and Japan) supply products for most of the other computer companies, both large and small. There's an excellent chance that you'll be able to match up any notebook from one company to at least one notebook from a different company. The trick is to locate one of these twins.

The best place to start is the FCC's online database, which maintains a listing of all companies that have received FCC approval for their products. Since many small companies don't have the resources to obtain FCC approval, they often rely on the original manufacturer to obtain the classification. And since all notebooks sold in this country are required to have FCC Class B certification, your orphaned machine may well have an FCC ID that you can use to start your search. The FCC ID is usually printed on the computer's nameplate, typically found on the bottom of the computer.

You can reach the FCC database using any communications program. Set it for 1200 baud, 7 data bits, even parity, and

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.

Frank J. Dertler, Jr., is senior networking editor and the author of the *PC Magazine Guide to Connectivity*.

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Joe Salemi is a contributing editor and the author of the *PC Magazine Guide to Client/Server Databases*.

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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion*, Second Edition.

Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

1 stop bit, then dial 301-725-1072. (There's a lot of traffic on this board, so keep dialing until you get through.)

After you connect, press Enter to get the opening menu. Select 1—Access Equipment Authorization Database—and you'll get another menu with two options: Equipment Authorization Ap-

plication Status, and Applicant/Grantee Names and Addresses by Code. The first option lets you enter the FCC ID of your computer. If the database finds a match, it displays the status of the ID and offers to display the name and address of the grantee.

If the database doesn't find a match, you may be able to locate the manufacturer using the second menu option. The code is the first three characters of the FCC ID number; enter these at the prompt, and the database will report the name and address of the grantee.

If the FCC database still fails to come up with a company, there is another way to find a twin machine for parts. Check *PC Magazine* and others for comparison reviews of notebooks with the same features (a 386SX processor in this case). Very small companies might not be covered in this type of review, but you might be able to identify a twin based on the specifications and product photographs. If you find one you think is a match, contact that company and see if they can confirm it. If it's a match, they should be able to supply you with the replacement power supply and any other parts you need.

One word of caution: Don't rely too heavily on the product photographs used in magazine advertisements. These ads are often put into production well before

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the actual product release, and dummy cases may be used in their places. It's still worth calling if you spot a machine that resembles yours, but don't count on the photograph's being an accurate representation of the product that is currently shipping.—*Alfred Poor*

Peripherals

REVIVING A PRINTER RIBBON

► **PC MAGAZINE:** It's axiomatic: Your laser printer will run low on toner and the ribbon on your dot matrix printer will fade right when you need to print an important document in a hurry. The laser printer problem is generally easy to solve; take out the toner cartridge and shake it back and forth a few times—this should redistribute the toner enough to get at least a few more pages out successfully. But what about dot matrix printers?

There are special re-inking devices you can purchase, but if you're stuck without a spare ribbon, it's not likely that you've planned ahead and purchased a re-inker, either. There is hope, however.

Take the ribbon cartridge out of the printer and carefully take the cartridge apart. Generally, the top of the plastic case can be pried off. You'll find the ribbon crammed inside the cartridge. Slightly moisten the top edges of the ribbon with a light penetrating oil (a spray can of WD-40 is ideal) and close the cartridge. Let it sit for about 15 minutes, then turn the knob on the cartridge to advance the ribbon a few inches before reinstalling it. Run a test print to make sure the ribbon is working properly, then print your document.

This trick works because the print-head doesn't strike the edge of the ribbon, so when the ink is worn from the path of the printhead, there's still some ink on the edges. The light oil causes the ink to flow down to the path of the print-head, and you can get at least a few more passes out of the ribbon.

Like shaking your toner cartridge, this is just a temporary fix, so be sure to buy a new ribbon as soon as possible. While you're at it, you might want to buy an extra one for the next time your ribbon fades at a critical moment.—*Alfred Poor*

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PC MagNet: Select Submissions to PC Magazine from the main PC MagNet menu. Upload your file to the most appropriate library. If at any time you need help, simply type a question mark (?) and hit Enter; a list of commands will be displayed. If you are not already a member of PC MagNet but would like to join, follow the instructions on page 12 to find your local access number.

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Operating Environments

ENHANCING BATCH FILES

❓ I use EDLIN within batch files to create other, temporary batch files. A similar editor with somewhat extended capabilities—wildcards in the replace procedure, for example—would let me build less complex and more powerful batch routines. Is there a souped-up EDLIN available?

Also, is there a program that can reliably convert my batch files to .COM or .EXE format? I've tried a few but they stall. Would I gain much from such conversions, especially since I already speed up the routines by using NDOS (the 4DOS subset bundled with The Norton Utilities, Version 6.1) and execute some or all operations from a RAMdisk?

*Daniel Brocki
Erie, Pennsylvania*

► **PC MAGAZINE:** EDLIN is a crude editor with a truly loathsome user interface, but this same primitive interface enables the utility to accept scripts of commands via

DOS redirection. An editor that is remotely pleasant to use interactively will almost certainly *not* accept commands from a script. Fortunately there are non-interactive alternatives to EDLIN such as SED.EXE, which is contained in SED.ARC and available for downloading from PC MagNet's Programming Forum. The archive also contains the documentation and source code for the program. SED is a freely distributable program that emulates the Unix text substitution utility of the same name. As with most Unix utilities, it's cryptic but powerful and it definitely includes the regular expression wildcard search-and-replace capability you asked for.

Will you see a difference in the speed at which batch routines run if you convert them to executables? Yes, the increase can be dramatic. Consider that to process each line of a batch file, DOS must open the file, read, parse, and interpret the line, and then execute the command. By contrast, a compiled batch program is loaded into memory all at once—every instruction having *already* been parsed, interpreted, and converted to machine code. Again, you'll find the solution on MagNet. Download the *PC Magazine*

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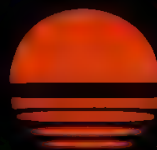
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utility BAT2EXEC from the Utilities/Tips Forum. The program is called BAT2EX.COM. BAT2EX.DOC holds the documentation and BAT2EX.ZIP contains the source code.

As you note, 4DOS runs batch files faster than MS-DOS since, unlike MS-DOS, it has the ability to load an entire batch file into memory at once (subject to certain restrictions). You activate the feature by giving the batch file the extension BTM. According to JP Software, this can speed up batch operation by two to five times. Still, a compiled batch file has the same advantages as a BTM file and it gains even more speed because its instructions have already been converted to executable machine code.

—Neil J. Rubenking

Word Processing

USING {PROMPT} AND {PAUSE} IN WP 5.1

TIP It's often useful in a WordPerfect macro to add a Prompt just before a Pause command, so that you can give a reminder for what you're supposed to do during the Pause. The format for the two commands together is

```
{PROMPT}Your message goes here ~ {PAUSE}
```

As it turns out, however, there's a bug in the March 30, 1990, release of WordPerfect 5.1 that won't let you use {PROMPT} and {PAUSE} together. If you try it, the prompt will simply not show up on the screen.

Derek Moreno
Pahrump, Nevada

►PC MAGAZINE: WordPerfect confirms this bug and says it's limited to the one release of 5.1. And if you're a registered user still using the March 30, 1990, version, you can call 800-451-5151 to get the current interim release for \$6 plus shipping and handling—a total of about \$8. If you write macros for others to use, however, you may want to use a work-around rather than risking a command that doesn't work on everyone's system.

There are actually several work-arounds available. The simplest is to use the {INPUT} command instead, which would take the form

```
{INPUT}Your message goes here ~
```

As when using {PROMPT} and {PAUSE}, this will put a message on the status line and let you type commands or text until you hit Enter to continue the macro.

Almost as easy is substituting the {STATUS PROMPT} command for the {PROMPT} command before the pause. You will then have to clear the message after the pause with another {STATUS PROMPT} command. The combination takes the form

```
{STATUS PROMPT}
Your message goes here ~
{PAUSE}{STATUS PROMPT} ~
```

Note that according to the WordPerfect manual, the {STATUS PROMPT} message will not show if display is set off with a {DISPLAY OFF} command. In my tests, however, the message displayed without problems even with a {DISPLAY OFF} command to start the macro.—M. David Stone

Spreadsheets

CUSTOMIZING QUATTRO PRO 4.0's SPEEDBAR

TIP Quattro Pro 4.0 has terrific fonts that are great for presentation spreadsheets and reports. On my dot matrix printer, however, the printing is a little slow. I use Funk Software's Sideways for vanilla printouts because it's faster and still allows a few special effects.

Sideways is available as an add-in for Lotus 1-2-3, but we Quattro Pro types have to use it in standalone mode. Fortunately, if you use a mouse, there's a way to make Sideways act as if it's an add-in. Just add it to your radio-button bar as follows:

- In Quattro Pro's READY mode, type /OB.
- Press the Enter key to select READY-

mode SpeedBar.

- Scroll down the list of buttons until you come to an undefined button (one that doesn't have any characters in the right column of the dialog box). Then press Enter.
- Press Enter to select Short name, then type SW and press Enter.
- Scroll down to Long name, press Enter, type Sideways, and press Enter.
- Scroll down to Macro. Press Enter, then type the following string:

```
/FUDsideways ~
```

Press Enter after typing that string.

- Type Q (for Quit) three times, then type U (for Update).

Now you can run Sideways by clicking the button bar. If you use Quattro Pro in character mode, the button to click is the one that reads SW. In WYSIWYG mode, the button will say Sideways. When you leave Sideways, you'll be right back in your Quattro Pro spreadsheet again.

Galen W. Sitler
Duarte, California

►PC MAGAZINE: The macro code /FUD invokes Quattro Pro's DOS shell. By following these characters with the name of a DOS executable and a tilde, you can create a macro that shells out to DOS and runs any program that fits in memory. As soon as the program you run is finished, the Quattro Pro DOS shell automatically returns you to the spreadsheet.

To find out how much memory you can use via the DOS shell on your system, execute the command /FUD (without using a macro) and press Enter. When the prompt arrives, type MEM. (Type CHKDSK instead of MEM if your version of DOS doesn't include the MEM command.) On a typical 640K computer, you'll have plenty of memory for small utility programs such as Sideways.

If you add a Sideways button to the end of your SpeedBar, as Mr. Sitler suggests, you will probably not see the button at first. Instead, the last button on the bar will say Bar. Click Bar to see the rest of your buttons, including the one you just added.

If you change your mind and want to unload the Sideways button, you'll need

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to type /OB and Enter again. Then, after selecting the button you added and pressing Enter again, go through each element of the menu (Short name, Long name, and Macro) and erase the contents of the ensuing dialog boxes. Quattro Pro doesn't offer a simple delete button command.

Here are a few more notes about customizing Quattro Pro's SpeedBars:

You can customize four separate SpeedBars—one each for Ready and Edit mode in character display and WYSIWYG display. To customize the Edit-mode SpeedBar, use the /OB command, then press E. To add a button to the character-mode version of a SpeedBar without changing the WYSIWYG-mode version, leave the Long name portion of the dialog box blank. To add a button only to the WYSIWYG bar, leave out the Short name.

Don't delete buttons from the middle of the bar. If you delete the third button, for example, all buttons from the third one to the end are suppressed.

When you use the Update command, Quattro Pro stores SpeedBar information in the file QUATTRO.MU. If you plan to do a lot of experimenting with the SpeedBar, you might want to back this file up before you begin.—*Craig Stinson*

FINDING A FILE'S PATH IN 1-2-3

TIP For a recent project, I needed a macro that would extract a file into the directory in which the current spreadsheet was stored. The macro's task was to determine which directory the current file had been retrieved from, then issue a /File Directory command to point to that directory. The solution I came up with is in Figure 1.

The macro stores the complete path of the current file in a label named NewDir. Then it initiates a FOR loop that works its way through NewDir from right to left, counting characters until it comes to a backslash. As soon as it finds a backslash, the FindSlash routine uses @LEFT to remove from NewDir all characters from the backslash to the end of the string. What's left in NewDir is the path of the current file. The last command

SSDIR.WK1 Complete Listing

	A	B
1	'\D	'{LET NewDir,@CELLPOINTER("filename")) ~
2		'{FOR Count,1,@LENGTH(NewDir),1,FindSlash}
3		'/FD(NewDir) ~
4		
5	'FindSlash	'{IF @MID(NewDir,@LENGTH(NewDir)-Count,1)="\"}{LET NewDir,@LEFT(NewDir,@LENGTH(NewDir)-Count)} ~ {FORBREAK}
6	'Count	
7	'NewDir	

Figure 1: This short Lotus 1-2-3 macro determines from which directory the current spreadsheet was retrieved, and then changes to that directory.

issues a /File Directory command, branches to NewDir to get the directory string, and then branches back to get the final return character.

*Richard Wendt
Philadelphia, Pennsylvania*

PC MAGAZINE: I suspect other readers may find this routine useful. 1-2-3, Release 3.x, and 1-2-3 for Windows include an @INFO function that can be used to get the current working directory. But @INFO("directory") does not return the home directory of the current file. In order to get that information, you need to perform string manipulation on @CELLPOINTER("filename"), as Mr. Wendt has done in his macro.

When creating this macro on your system, be sure to assign the names \D, FindSlash, Count, and NewDir to the cells immediately to the right of those labels. And note that the FindSlash routine in this macro must all be coded in a single worksheet label.—*Craig Stinson*

Databases

INCREMENTING ALPHANUMERIC KEYS

TIP I use alphanumeric keys to accommodate a greater number of unique values. For example, if a character field with a width of three were to contain only numeric data, it would have a maximum of 1,000 unique values. However, if you use both numbers and the characters A through Z, a three-character field yields 46,656 (36³) unique possibilities.

The problem is generating the next

key value from an existing key. The simple routine in Figure 2 does this job.

*Kayin Tong
Palisades Park, New Jersey*

PC MAGAZINE: This function takes a character key consisting of any one of the uppercase characters A to Z or the numbers 0 to 9 and produces the next incremental value. After executing

```
cK = NxtKeyCod("A01")
```

the character variable cK will equal A02.

Clipper borrows the dBASE III Plus .DBF file structure, storing numeric data in ASCII form. Hence NxtKeyCod() saves disk space by increasing the number of unique values you can store in a given field width.

The function starts returning letters after the number 9. So, a sequence of six calls to NxtKeyCod() starting with the key A06 would return, consecutively,

A07
A08
A09
A0A
A0B
A0C

NxtKeyCod() uses asterisks to indicate that you've run out of keys. For instance, a sequence of six calls beginning with the key ZZW would return

ZZX
ZZY
ZZZ

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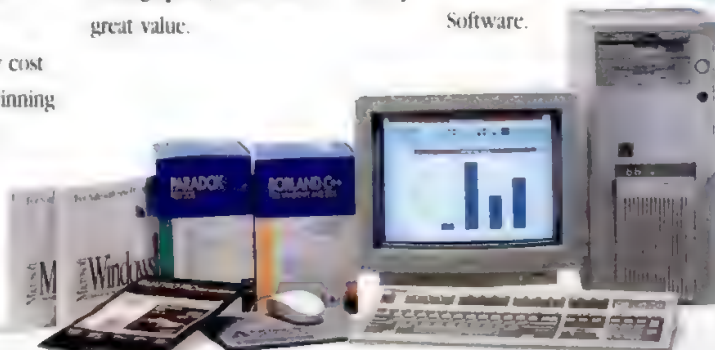
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NxtKeyCod Function

Complete Listing

```

.....
* FUNCTION NxtKeyCod                               Clipper 5
* Increments a key code of serial number that is made up of
* letters and numerals.
*
* - The characters used in the code are from 0 - 9 and then A - Z
*   in ascending order.
* - The previous key code passed to this procedure should have the
*   maximum length allowed so that the system can check whether
*   the next key code will exceed the limit.
* If so, it returns all ***.
* - Spaces are treated as '0'. Trailing spaces are significant and
*   replaced by '0', while leading spaces will remain unchanged
.....
FUNCTION NxtKeyCod( ckeycode )
LOCAL cchrbank, nkeylen, nct, cwkchr, nwchrseq
cchrbank = "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ"
nkeylen = LEN( ckeycode )
ckeycode = SUBSTR( TRIM( ckeycode ) + ;

```

```

REPLICATE( "0", nkeylen ), 1, nkeylen )
FOR nct = 1 TO nkeylen
  cwkchr = SUBSTR( ckeycode, -1 * nct, 1 )
  cwkchr = IIF( cwkchr = " ", "0", cwkchr )
  nwchrseq = AT( cwkchr, cchrbank )
  nwchrseq = nwchrseq + 1
  nwchrseq = IIF( nwchrseq > LEN( cchrbank ), 1, nwchrseq )
  cwkchr = SUBSTR( cchrbank, nwchrseq, 1 )
  ckeycode = SUBSTR( ckeycode, 1, nkeylen - nct ) + cwkchr + ;
    SUBSTR( ckeycode, nkeylen - nct + 2 )
  IF nwchrseq != 1
    EXIT
  ELSEIF nct = nkeylen
    ckeycode = REPLICATE( "***", nkeylen )
  ENDIF
NEXT
RETURN ckeycode

```



Figure 2: A Clipper function that returns the next sequential value when passed an alphanumeric key.

The algorithm, in its simplified form, starts with the rightmost character and moves to the left. If the character is less than Z, it increments it and exits. If the character happens to be Z, it sets it to 0 and then processes the next character to the left of it. If there is no next character, the string was set to all Zs and the result is set to asterisks.

You'll notice in the code that Clipper accepts a negative value for the start position in the SUBSTR() function. This differs from other Xbase dialects, which will usually indicate an error or return a null string when passed a negative start position. In Clipper, when the start position is negative, it is relative to the rightmost character in the string. Of course, when the start position value is positive, it is relative to the leftmost character as with other Xbase packages. For example, SUBSTR("ABCD", -2, 1), relative to the right, returns "C"; while SUBSTR("ABCD", 2, 1), which is relative to the left, returns "B".

You can download the NxtKeyCod function from PC MagNet. Look for the NXTKEY.PRG file in the Databases section.—*Sal Ricciardi*

mmmm ddss, yyyy

where ss is the suffix.

Larry Siemiaszko
Freehold, New Jersey

► **PC MAGAZINE:** Everyone needs a function like this at one time or another. It works by recognizing that most cases use the suffix *th*. So the Switch-Endswitch block identifies the exceptions and lets all of the others default to *th*.

To use this in your PAL code, you could try something like

```

MESSAGEMOY(t) + " " +
STRVAL(DAY(t)) +
Daysuf(t) + ", " +
STRVAL(YEAR(t))

```

This would display the date *t* in the for-

mat Sep 21st, 1992. DAYSUF.SC is available on PC MagNet in the Utilities/Tips Forum.—*Sal Ricciardi*

Graphics

USING YOUR HEADER

❓ I'm an art director and receive files from a number of illustrators who use many different graphics programs, which causes a persistent problem for me—incompatible TIFF files. The most recent example involved a picture created with Mathematica's Tempra Pro. I couldn't import the image into Aldus PhotoStyler. Why do some TIFF files cause no trouble, while others are impossible to use?

Ann Burns
New York, New York

DAYSUF.SC

Complete Listing

```

; -----
; DAYSUF.SC                                     Paradox
; Accepts a date and returns the appropriate day suffix
; for the day number. For example, returns st for 21,
; th for 15, rd for 3 and so on.
; -----
PROC Daysuf(t)
  SWITCH
    CASE DAY(t) = 1 OR DAY(t) = 21 OR DAY(t) = 31
      : c = "st"
    CASE DAY(t) = 2 OR DAY(t) = 22
      : c = "nd"
    CASE DAY(t) = 3 OR DAY(t) = 23
      : c = "rd"
    OTHERWISE
      : c = "th"
  END SWITCH
  RETURN c
ENDPROC

```



Figure 3: A PAL procedure that returns the appropriate day suffix for the day number.

GETTING THE ORDINAL DAY NUMBER SUFFIX IN PAL

✓ **TIP** I sometimes need to express a date using an ordinal day number, such as Sep 21st, 1992. The PAL function shown in Figure 3 will accept a date expression and return a string with the appropriate suffix inserted. The string is in the form

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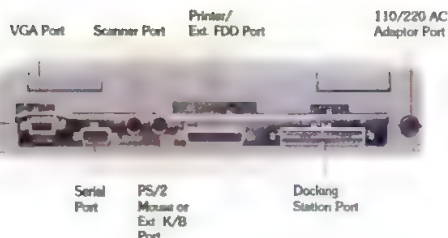
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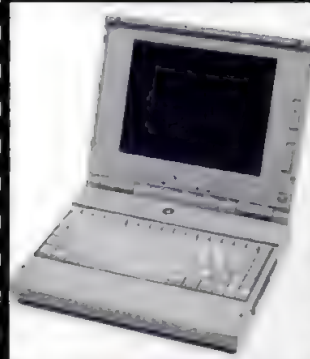
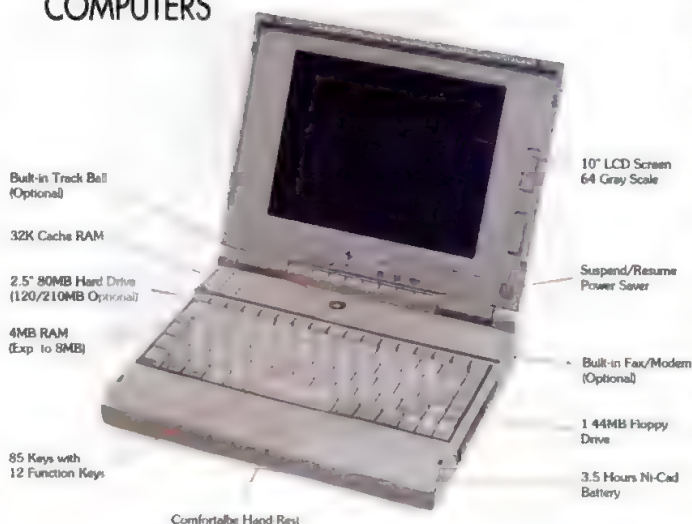
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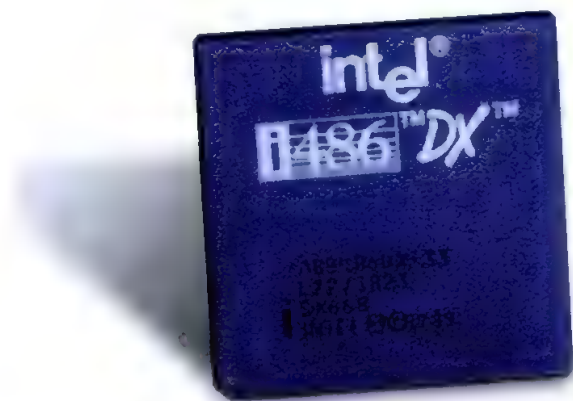
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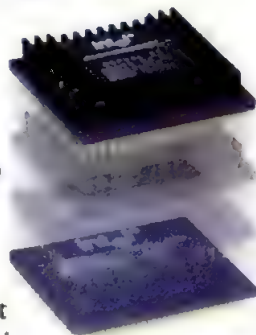
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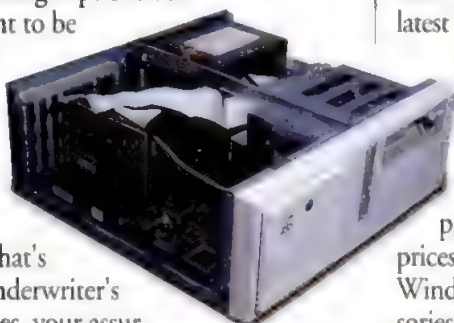
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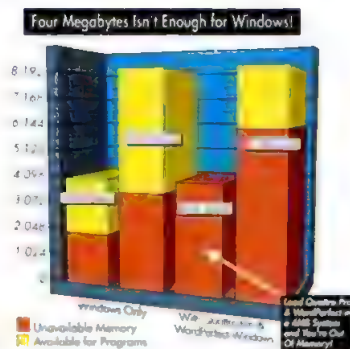
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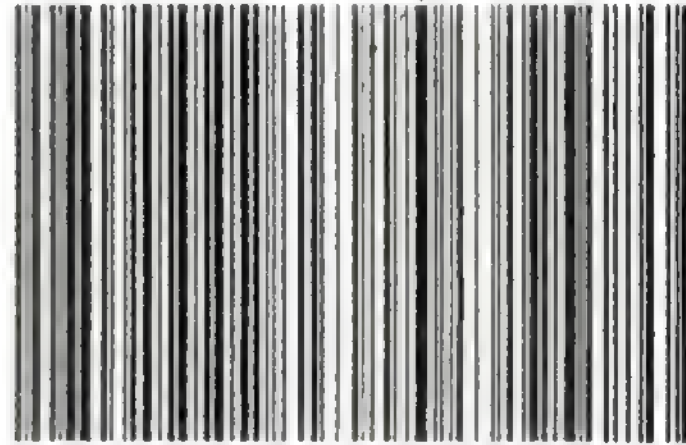
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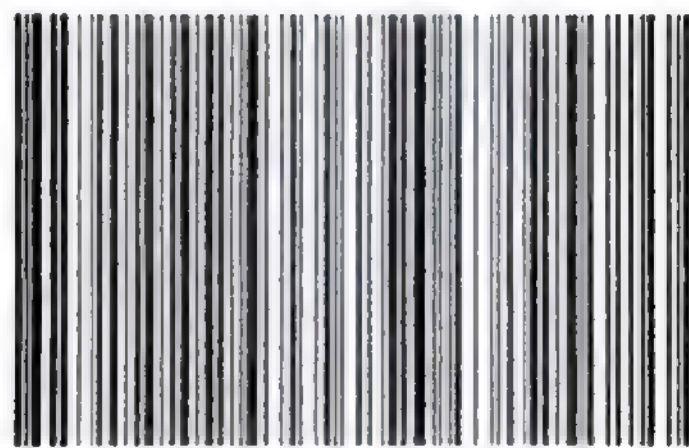
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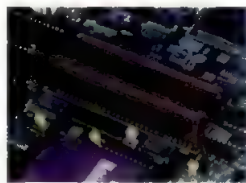
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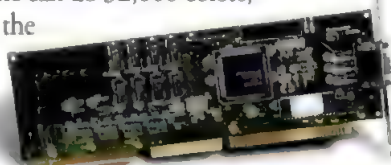
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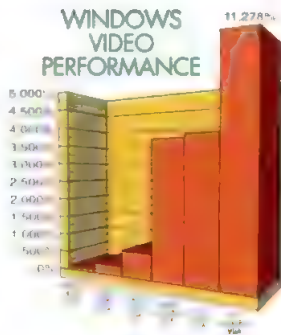
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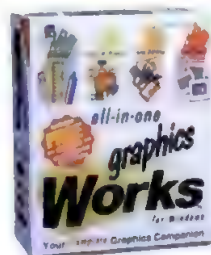


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FastMicro includes the real thing: a Microsoft Mouse.



True Intel 486 for Less Than \$1,000!

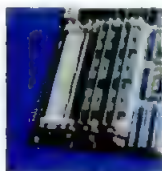


Introducing FastMicro's 486/Valueline.

Don't need all the extra features of our 486/Pro Series? Then the 486/Valueline is right for you. This system is truly a price breakthrough! FastMicro delivers a high performance 486 system at a low end price. Others can only offer a 386/SX for less than \$1000 or substitute an imitation 486 that's more like a 386. FastMicro puts 25MHz 486SX power in your hands. Plus this isn't a 'bare' system, you get a system that's complete and ready-to-run right out of the box, including a Super VGA color monitor and card.

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FastMicro also includes four full megabytes of high-speed SIMM

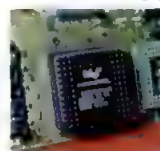


memory! You can even expand the memory to a total of 32MB. Of course, how can you also expect to get a hard drive at this price? Well, FastMicro includes a quality Conner hard drive with an unbelievable 85MB capacity. Plus, since it's a standard IDE drive, you can easily add a second hard drive later.



Upgradable to OverDrive Processors!

The best part of this system is that you get legendary FastMicro upgradability too! Besides upgrading the memory and drive, you can upgrade later to a faster Intel processor. This system is completely Intel OverDrive™ compatible; which means you can upgrade your FastData 486 system all the way to a 66 MHz 486DX/2! And like all FastMicro systems, you can upgrade monitors, drives, etc. when you order.



Plus, It's from FastMicro!

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► **PC MAGAZINE:** TIFF (or Tagged Image File Format) is one of the most versatile—and frustrating—formats on the market today. It's versatile because the latest version of the TIFF specification (6.0) supports many different imaging technologies. That same versatility, though, creates the frustration: Given all the possible variations and combinations, conflicts are bound to arise. A vendor might support only a subset of the TIFF specification. If another program doesn't provide the same or overlapping functions, it will exhibit compatibility problems. It is particularly annoying that applications tend to be great at telling you they can't import a particular file, but universally terrible about telling you *why* they can't.

When I encounter a troublesome TIFF, I immediately try to identify its specific variation (also called *flavor*)—not a trivial task. Version 1.0 of the specification, introduced by Aldus in 1986, supported only black-and-white bitmapped images, although it did boast cross-platform compatibility with the Macintosh. Times change. Today a TIFF image might be black-and-white, grayscale or full-color. It can employ various color models—indexed color, RGB, CYMK, CIE L*a*b (a device-independent color model developed by the Commission Internationale de L'Eclairage, an international standards committee), and even YCbCr (the new Kodak format that specifies the hue and chroma components of digitized video). TIFF images can be stored either uncompressed or compressed using one of a few schemes—LZW, Packbits or Jpeg. Macintosh-

generated TIFF files contribute still another twist—literally—reversing the byte order found in PC TIFF files.

Start your detective work by first carefully examining Tempra Pro's manual or Save As dialog box. You'll learn that the program can produce 8- or 24-bit compressed or uncompressed TIFF images. For more detailed information, though, you'll need to peek inside the Tempra Pro .TIF file and read its *header (tag)*—a section (in addition to the image data area) found in all properly behaved TIFF files that stores important identifying information about the file. The header tells a lot about a TIFF file and—best of all—without forcing you to touch the troublesome image data. The byte order is specified here (by chip type, as either Intel-based, indicating a PC; or Motorola-based, indicating a Mac). The header also indicates the number of bits per pixel and the compression scheme employed.

Figure 4 shows the information stored in a sample TIFF header from (in this case) a compressed, 8-bit, grayscale image. You can generate this screen with TIFFDUMP.EXE, a small (and easily overlooked) utility that ships free with PhotoFinish and PC Paintbrush V Plus from ZSoft (voice: 404-428-0008).

Although your letter doesn't specifically mention compression, I'd guess you experienced the compatibility problem with a compressed color TIFF image. Tempra Pro uses Packbits compression for all images—whether black-and-white, grayscale or color—but Aldus PhotoStyler supports it for black-and-white images only. PhotoStyler (like other mainstream graphics products)

uses the more advanced LZW compression scheme for grayscale and color images.

Because you receive TIFF files from so many different sources, you should own a utility program that is able to read the headers. Actually, you already have one if you use PhotoFinish or PC Paintbrush V Plus, since ZSoft bundles TIFFDUMP.EXE with them. Unfortunately, the utility is available only as part of the ZSoft products, not separately. With a little extra effort,

though, you can download a free TIFF reader from the Aldus developers forum on CompuServe. Just type GO ALDSVC at the prompt. You'll find the files in CIS-Library 10. Both the TIFF reader and the forum itself are intended for developers who are writing TIFF import filters, so be prepared for a bare-bones DOS utility and minimal support.

Of course, there's a world of difference between knowing the cause of a problem and solving the problem. Here

***Tagged Image File
Format is one of the
most versatile—and
frustrating—formats
on the market today.***

are a few possible solutions.

You can open the offending TIFF file within the original application (in this case Tempra Pro) and save it as an uncompressed image. As I've learned through experience, this solves most incompatibility problems. Alternately, you could return to Tempra Pro and save the picture in a totally different format, such as .BMP (the Windows bitmap format). If you're working with high-resolution, 24-bit images, you'll find it impossible to fit the file on a floppy disk, but you can resort to using a third-party compression utility (such as PKZip).

These solutions share one drawback—they only work if you have access to the originating application. In a production environment with deadline pressures, you may need a more direct way to convert incompatible files to an acceptable format.

HiJaak for Windows from Inset Systems (voice: 203-775-5866) offers a viable alternative. This \$249 file-conversion and screen-capture utility supports 34 flavors of TIFF. Many are identified by a specific application name, such as Aldus PageMaker 4.0 or Microsoft Word for Windows. The solution to your puzzle may be as simple as opening the problematic TIFF file in HiJaak for Windows and then saving it to a compatible flavor. In

```
C:\SOLUTION>tiffdump sample.tif
Copyright 1990, ZSoft Corporation
Version 2.0

      Byte Order: Intel
      Image Number: 1
Image Size - Width x Height: 662 x 1312 pixels.
      Number of colors: 256
      Compression Scheme: LZW

      Bits per sample: 8
      Samples per pixel: 1
Approximate size: 1157184 bytes uncompressed
      X resolution: 150 dots per inch
      Y resolution: 150 dots per inch

Enter command (C,B,G,M,N,Q,T):
```

Figure 4: This shows the information stored in a sample TIFF header from a compressed, 8-bit, grayscale image.

Graphics...Networking...Languages

fact, I tried this method with a Tempra Pro TIFF file and it worked just fine.

Impressively, HiJaak also has the ability to create new flavors of TIFF. Whenever you use the Convert or Save As commands (located on the File menu), HiJaak allows you to access advanced processing options. Click the Custom button contained in the TIFF Options dialog box and HiJaak will ask you to identify the flavor you want to add. Identifying the new one requires no technical expertise—you simply select a sample file of the desired flavor and click OK. HiJaak does the hard work of analyzing the file type and creating a new flavor of TIFF. You even get to specify the name of the new flavor.

Technically speaking, Tempra Pro remains blameless for the compatibility problem. Although it would help if the product offered LZW compression, the Packbits compression scheme lies totally within the TIFF specification's bounds.

Keep one fact in mind, then—as Tempra Pro proves, a TIFF file can be legal but still be incompatible, so learning to identify and solve compatibility problems is an essential skill if you accept TIFF files from a number of different sources.—Luisa Simone

Networking

SERVER ROOM MELTDOWN

❷ We keep our servers and 10BaseT hubs in the same room. As we continue to expand, though, the place is becoming a jumble of computers, monitors, keyboards, and uninterruptible power supplies. Apart from the clutter, heat is now becoming a problem. It would help if all the servers shared a single monitor and keyboard. Can you advise us about the best way to do this? We also wonder about using a single, large UPS instead of many small ones. We'd like to avoid any change that lessens reliability.

Stephen Drew
Miami, Florida

► **PC MAGAZINE:** If reliability is a major concern, then first tackle your heat problem with proper air conditioning. After that, you can join the argument over one

large UPS versus several smaller devices. It comes down to personal choice, but I favor multiple units. A single UPS certainly has advantages—it operates more efficiently; you only have one set of batteries to worry about; and it can safeguard everything from wiring hubs (which need little power, but 100 percent protection) to the most massive disk drive arrays. Then again, it will weigh hundreds of pounds and present a single point of failure.

Although you'll probably pay more for a multiple UPS setup and have several sets of batteries to worry about, keeping spares on hand and replacing failed units will be easier. I'd suggest you buy a group of identical devices from the same manufacturer so you can easily swap them around.

Getting rid of little-used monitors can reduce crowding and help the heat problem, too. Rose Electronics (voice: 713-933-7673) sells a small device called the ServeView that lets as many as four servers share the same VGA color monitor, keyboard, and mouse. The box itself carries a retail price of \$695. You'll also need special cables (\$45 apiece) to make the connection to each server—a total outlay of \$875 to control four systems.

Sharing of input devices requires more than just switching cables—it takes some tricks, since computers issue errors if they don't see a keyboard when they boot, and since applications (operating systems, too) often refuse to work with a mouse if they don't sense one on startup. ServeView emulates the keyboard and mouse on every port, ensuring that software and hardware continue to function correctly. It even preserves the keyboard mode information, saving you from the need to reset the Caps Lock and Num Lock every time you switch servers.

You control which server connects to the input devices in one of three ways: through the keyboard, by way of a separate ServeView serial port, or using a front panel switch. We leave the ServeView in scan mode so it displays each system's screen in rotation. For heat reduction, space and power conservation, and convenience, ServeView certainly makes a good deal of sense.

Anyone with a room full of NetWare servers should also look at a free utility—

the Console Screen Saver—from Frye Computer Systems. Download it from the company's BBS at 617-426-1910. This small NLM (15K) shows a real-time graph of server load and moves it around the screen to prevent burn-in. It's a nice way to keep tabs on your server without taking the RAM required to run Novell's Monitor program. Call Frye at 617-556-9299 for more information. The Console Screen Saver and a scanning ServeView make a nice combination.

—Frank J. Derfler, Jr.

NETWORK SUPPORT

► **PC MAGAZINE:** The Cobb Group, a subsidiary of Ziff-Davis (our parent company), now publishes an industry newsletter called *Inside NetWare*. From what I've seen in the most recent issues, I'd recommend it to anyone who manages NetWare servers in a business environment. A year's subscription—12 issues—costs \$89, but this is stuff you'll put in a three-ring binder and keep close to your desk.

Beginning in September, The Cobb Group teamed up with a company called 900-Support to provide two pages of fixes and patches in every issue. Written by Novell and compiled by 900-Support, the fixes and patches are arranged for quick reference. Call The Cobb Group at 502-491-1900 or send them a fax at 502-491-4200 to subscribe.—Frank J. Derfler, Jr.

Languages

CORRECTION

► **PC MAGAZINE:** A few unfortunate errors crept into the article "Clearing BASIC Variables" that appeared in the Languages section of the January 12, 1993, Solutions column. In the first paragraph, the last sentence should have read, "And while you can quickly clear a string to all CHR\$(32) blanks using LSET Work\$ = "", there's no way to assign any other character."

Additionally, the code in Figures 9 and 10 was inadvertently combined and printed incorrectly. Corrected versions of the two code listings appear here as Figures 5 and 6.

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Notebook Features:	CompuAdd Express 425Color		
Processor	Cyrix CX486SLC rated at 25MHz		
RAM	8MB expandable to 20MB		
Hard Drive	120MB		
Trackball	Built-in		
Fax/Modem	Built-in, FREE Bit-Fax software		
Simultaneous Display Capabilities	Yes		
Screen type/size	Passive Matrix/8.5"		
Floppy Drive	1.44MB 3.5"		
Ports	1 RS-232 Serial Port		
	1 Parallel/Printer Port		
Weight	6.3 lbs (including battery)		
Software	FREE Windows 3.1, MS DOS 5.0,		
	Close-Up 4.0, Lotus software option		
Size	8.5 x 11.5 x 2		
Accessories	FREE Carrying Case		
	FREE International Adapter		
Remote Rescue online support	✓		
Automatic virus protection	✓		
30-day money back guarantee	✓		
30-day exchange policy	✓		
1-year limited warranty	✓		
Factory repairs within 3 days	✓		
Toll-free technical support	✓		
Technical bulletin board	✓		
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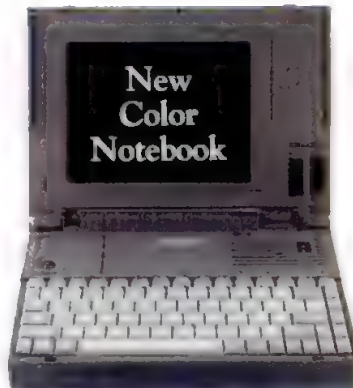
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MEMCLEAR.BAS

Complete Listing

```
'MEMCLEAR.BAS - shows how to initialize variables to any value
'Copyright (c) 1992 Ethan Winer

DEFINT A-Z
DECLARE SUB MemClear (Segment, Address, Size, Value)

TYPE Test
  I AS INTEGER
  L AS LONG
  S AS SINGLE
  D AS DOUBLE
END TYPE

DIM TestType AS Test          'create a test TYPE variable
TestType.I = 123              'and assign some values
TestType.L = -123456
TestType.S = 123.456
TestType.D = -123.456

REDIM A$(1 TO 150)           'create a test array
FOR X = 1 TO 150              'and assign some values
  A$(X) = X
NEXT

SS = SPACES(200)              'create a test string
FOR X = 1 TO 200              'and assign some values
  MID$(SS, X, 1) = CHR$(X + 35)
NEXT

GOSUB Display                  'show the current contents
PRINT
PRINT "Press a key to clear the variables"
WHILE INKEY$ = "": WEND

'set the TYPE and array elements to all zeros, and the string to "A"s
CALL MemClear(VARSEG(TestType), VARPTR(TestType), LEN(TestType), 0)
CALL MemClear(VARSEG(A$(1)), VARPTR(A$(1)), 200 * LEN(A$(1)), 0)
CALL MemClear(SSEG(SS), SADD(SS), LEN(SS), 65)
'AAAA
'----- use VARSEG here instead of SSEG with QuickBASIC

GOSUB Display
END
```

```
Display:
CLS
PRINT "TestType elements:"
PRINT "TestType.I :"; TestType.I
PRINT "TestType.L :"; TestType.L
PRINT "TestType.S :"; TestType.S
PRINT "TestType.D :"; TestType.D
PRINT

PRINT "A$( ) elements:"
FOR X = 1 TO 150
  PRINT A$(X);
NEXT

LOCATE 18, 1
PRINT "SS contents:"; SS
RETURN

ClearCode:
DATA &H55, &H8B, &HEC, 6, &HC4, &H7E, &HA, &H8B, &H4E, 8
DATA &H8B, &H46, 6, &HF3, &HAA, 7, &H5D, &HCA, 8, 0

SUB MemClear (Segment, Address, Size, Value) STATIC

IF NOT BeenHere THEN          'do this only once
  DIM Code AS STRING * 20
  RESTORE ClearCode
  FOR X = 1 TO 20
    READ Byte
    MID$(Code$, X, 1) = CHR$(Byte)
  NEXT
  Proc = VARPTR(Code$)
  BeenHere = -1
END IF

DEF SEG
Absolute(BYVAL Segment, BYVAL Address, BYVAL Size, BYVAL Value, Proc)

END SUB
```



Figure 5: MEMCLEAR.BAS shows how to quickly initialize any BASIC variable to any value, and it works correctly with all versions of Microsoft QuickBASIC including QBasic and BASIC PDS.

MEMCLEAR.ASM

Complete Listing

```
;MEMCLEAR.ASM - clears memory to any value
;
;Usage:
;
; CALL MemClear(
BYVAL Segment%, BYVAL Address%, BYVAL NumBytes%, BYVAL Value%)
;
;or
;
; CALL MemClear(SEG Array(Start), BYVAL NumBytes%, BYVAL Value%)
;
;or
;
; CALL MemClear(SEG Variable, BYVAL NumBytes%, BYVAL Value%)

.MODEL Medium, Basic
.CODE

MemClear Proc, Dest:DWord, NumBytes:Word, Value:Word

  Les DI, Dest
  Mov CX, NumBytes
  Mov AX, Value
  Rep Stosb
  Ret

MemClear Endp
END
```

VISUAL BASIC LINE BUG

TIP I would like to relate a bug I discovered in the Visual Basic Line command, and also offer a simple cure. The bug is easily demonstrated by the following code fragment, which should produce three lines parallel to the y-axis starting at y=100 and ending at y=200.

```
ScaleMode = 3          'unit is one pixel
Col = 0%                'black
Line (100, 200)-
(100, 100), Col = 'draw up
Line (105, 100)-
(105, 200), Col = 'draw down
Line (110, 200)-
(110, 100), Col = 'draw up
```

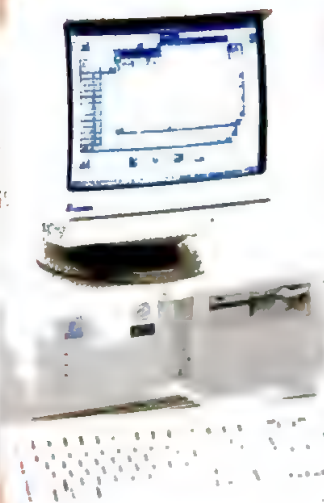
Unfortunately, the lines stop one pixel short, so that the outer lines extend from y=200 to y=101 and the inner line extends from y=100 to y=199.

The problem becomes apparent when you attempt to draw a closed outline, and



Figure 6: The assembly language source code underlying the DATA statements in MEMCLEAR.BAS.

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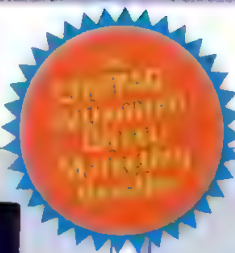
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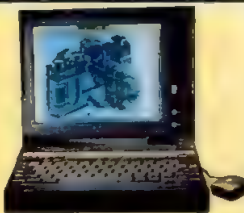
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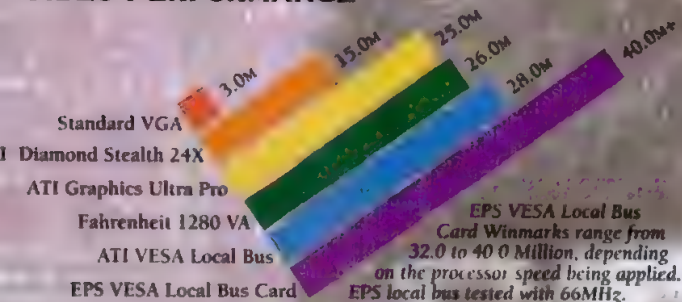
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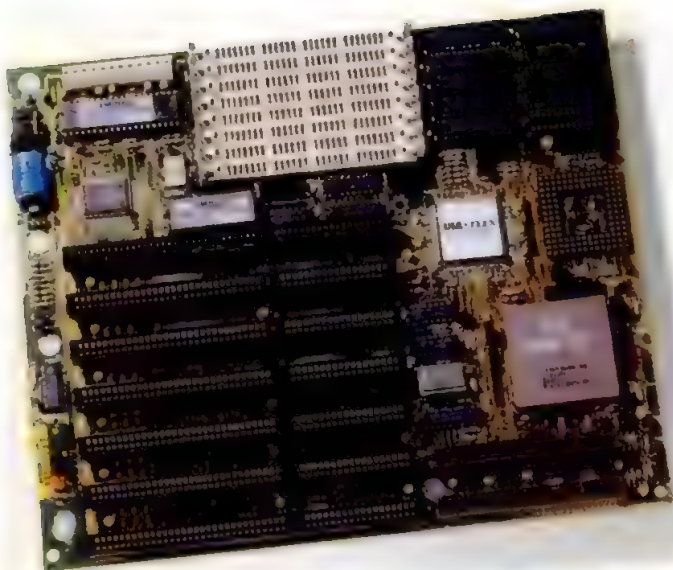
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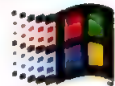
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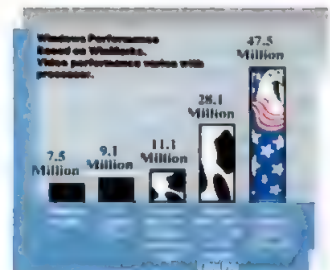
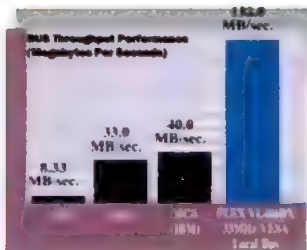
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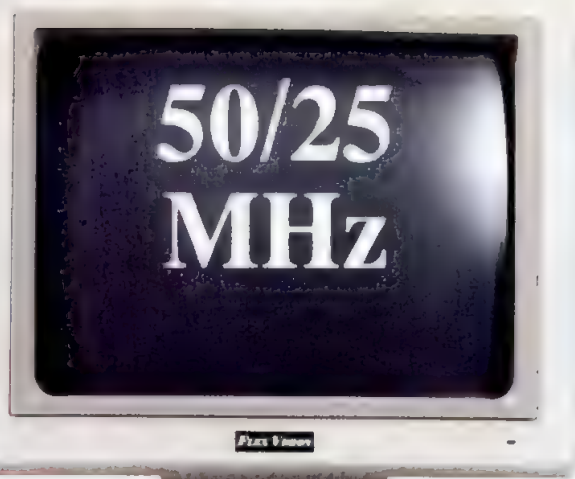
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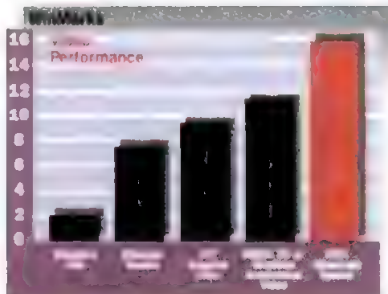
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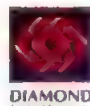
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Line-Drawing Subprogram for VB

```
Sub LineAbs (X1%, Y1%, X2%, Y2%, C1r%)
  XAdd% = Sgn(X2% - X1%)
  YAdd% = Sgn(Y2% - Y1%)
  Line (X1%, Y1%)-(X2% + XAdd%, Y2% + YAdd%), C1r%
End Sub
```

Figure 7: This Line replacement subprogram draws the entire line as specified, rather than one pixel less as Visual Basic's Line command does.

then use FloodFill from the GDI function library to fill the enclosed area. Because the lines have missing pixels, the outline is not properly closed and color leakage eventually floods the entire screen. My solution was to create a subprogram wrapper that intercepts the Line parameters, and adjusts for the incorrect way lines are drawn.

*R.D.B. Fraser
Tewantin, Australia*

► **PC MAGAZINE:** Visual Basic's Line statement draws a line from the first point specified, up to, but not including, the endpoint of the line. This behavior is not documented anywhere that I am aware of, and it has subsequently caused a great deal of confusion for VB programmers—especially those who have become accustomed to DOS BASIC where the endpoints are drawn.

The documentation does, however, state the following: "When drawing lines that are connected, they should be drawn so that after the initial line is drawn, subsequent lines begin at the endpoint of the previous line." Although it's badly worded, this correctly implies that the endpoints of lines are not drawn.

Visual Basic's Line statement mirrors that of the Windows API LineTo function, which also draws a line up to but not including the endpoint specified. In fact, all Windows rectangle functions work this way.

While Visual Basic's Line statement is consistent with that of Windows, the Box option works the same as DOS BASIC and the second set of coordinates are included in the rectangle.

I made a few changes to Mr. Fraser's Line replacement subprogram to make it slightly more efficient, and the result is shown in Figure 7. Note that the coordinates must be given as whole-number values in pixels.—*Ethan Winer*

Special Needs

MAKING TWO-KEY COMBINATIONS STICKY

❷ I'm a disabled computer user with limited hand use. Most of the software I've attempted to use has two-key combinations, such as Ctrl-P and Alt-L, which are almost impossible for me to type. Do you know of any software programs designed for the disabled that may be easier for me to use?

*Peter M. Aviles
Caldwell, Idaho*

► **PC MAGAZINE:** A better solution than purchasing all new software is purchasing a utility or add-in that makes control-key combinations "sticky," so that the first key in the combination stays active until you press the second key. While few commercial products have an option to make their keys sticky, STAYDOWN, a *PC Magazine* TSR utility, does just this. Written by contributing editor Jeff Prorise, the STAYDOWN utility makes the Ctrl, Alt, and Shift keys sticky and works with just about every DOS pro-

gram available today, including most memory-resident utilities that require two keystrokes to be activated. The utility first appeared in the April 26, 1988, Utilities column and can be downloaded from PC MagNet's Utilities/Tips Forum as STAYDN.COM. If you're interested in the source code and documentation as well as the executable program, you can download the file STAYDN.ARC. (See the "Utilities by Modem" sidebar in Utilities for downloading instructions.)

For Windows users, Microsoft's Access Pack for Windows is a set of drivers that add sticky-key capabilities to Windows 3.x applications. You can get the Access Pack by downloading it from the Microsoft Software Library on CompuServe as ACCP.EXE. Or you can contact Microsoft directly at 800-426-9400 and order the Access Pack disk for a \$20 shipping and handling fee.

OS/2 2.0 has built-in support for sticky keys. Once the sticky-key option is turned on, all OS/2 applications have the ability. The option is turned on through the Keyboard icon in the System Settings folder. Activating the Keyboard icon brings up the settings folder, which has a tab called Special Needs. The sticky key option is activated by turning on the Settings Activation button in the upper-left corner of the window. The screen shot in Figure 8 shows the special needs page of the keyboard settings notebook.

Once you've turned on the setting, you can make any key on the keyboard sticky by hitting the Shift key three times; the key that immediately follows will now act like it's being held down. OS/2 also issues a tone from the PC's speaker to let you know the sticky key activation worked. For example, if you wanted to use the Ctrl-P key combination, you would use the following sequence of keys: Shift, Shift, Shift, Ctrl <tone>, P. If you wanted to hit the Ctrl-Alt-Del combination to reboot the system, you would use Shift, Shift, Shift, Ctrl <tone>, Shift, Shift, Shift, Alt <tone>, Del. OS/2 implementation of sticky keys is a bit klunky, but it works, even in DOS and Windows sessions.—*Joe Salemi* □

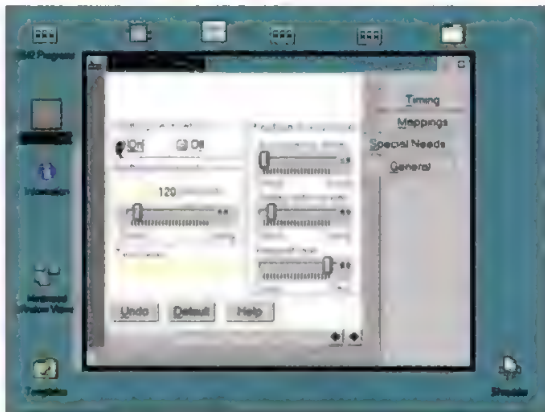


Figure 8: OS/2 2.0 lets you make the shift keys sticky through the special needs page of the keyboard settings notebook.

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Line-Drawing Subprogram for VB

```

Sub LineAbs (X1%, Y1%, X2%, Y2%, CClr%)
  XAdd% = Sgn(X2% - X1%)
  YAdd% = Sgn(Y2% - Y1%)
  Line (X1%, Y1%)-(X2% + XAdd%, Y2% + YAdd%), CClr
End Sub

```

Figure 7: This Line replacement subprogram draws the entire line as specified, rather than one pixel less as Visual Basic's Line command does.

then use FloodFill from the GDI function library to fill the enclosed area. Because the lines have missing pixels, the outline is not properly closed and color leakage eventually floods the entire screen. My solution was to create a subprogram wrapper that intercepts the Line parameters, and adjusts for the incorrect way lines are drawn.

*R.D.B. Fraser
Tewantin, Australia*

► **PC MAGAZINE:** Visual Basic's Line statement draws a line from the first point specified, up to, but not including, the endpoint of the line. This behavior is not documented anywhere that I am aware of, and it has subsequently caused a great deal of confusion for VB programmers—especially those who have become accustomed to DOS BASIC where the endpoints are drawn.

The documentation does, however, state the following: "When drawing lines that are connected, they should be drawn so that after the initial line is drawn, subsequent lines begin at the endpoint of the previous line." Although it's badly worded, this correctly implies that the endpoints of lines are not drawn.

Visual Basic's Line statement mirrors that of the Windows API LineTo function, which also draws a line up to but not including the endpoint specified. In fact, all Windows rectangle functions work this way.

While Visual Basic's Line statement is consistent with that of Windows, the Box option works the same as DOS BASIC and the second set of coordinates are included in the rectangle.

I made a few changes to Mr. Fraser's Line replacement subprogram to make it slightly more efficient, and the result is shown in Figure 7. Note that the coordinates must be given as whole-number values in pixels.—*Ethan Winer*

Special Needs

MAKING TWO-KEY COMBINATIONS STICKY

❗ I'm a disabled computer user with limited hand use. Most of the software I've attempted to use has two-key combinations, such as Ctrl-P and Alt-L, which are almost impossible for me to type. Do you know of any software programs designed for the disabled that may be easier for me to use?

*Peter M. Aviles
Caldwell, Idaho*

► **PC MAGAZINE:** A better solution than purchasing all new software is purchasing a utility or add-in that makes control-key combinations "sticky," so that the first key in the combination stays active until you press the second key. While few commercial products have an option to make their keys sticky, STAYDOWN, a *PC Magazine* TSR utility, does just this. Written by contributing editor Jeff Prosis, the STAYDOWN utility makes the Ctrl, Alt, and Shift keys sticky and works with just about every DOS pro-

gram available today, including most memory-resident utilities that require two keystrokes to be activated. The utility first appeared in the April 26, 1988, Utilities column and can be downloaded from PC MagNet's Utilities/Tips Forum as STAYDN.COM. If you're interested in the source code and documentation as well as the executable program, you can download the file STAYDN.ARC. (See the "Utilities by Modem" sidebar in Utilities for downloading instructions.)

For Windows users, Microsoft's Access Pack for Windows is a set of drivers that add sticky-key capabilities to Windows 3.x applications. You can get the Access Pack by downloading it from the Microsoft Software Library on CompuServe as ACCP.EXE. Or you can contact Microsoft directly at 800-426-9400 and order the Access Pack disk for a \$20 shipping and handling fee.

OS/2 2.0 has built-in support for sticky keys. Once the sticky-key option is turned on, all OS/2 applications have the ability. The option is turned on through the Keyboard icon in the System Settings folder. Activating the Keyboard icon brings up the settings folder, which has a tab called Special Needs. The sticky key option is activated by turning on the Settings Activation button in the upper-left corner of the window. The screen shot in Figure 8 shows the special needs page of the keyboard settings notebook.

Once you've turned on the setting, you can make any key on the keyboard sticky by hitting the Shift key three times; the key that immediately follows will now act like it's being held down. OS/2 also issues a tone from the PC's speaker to

let you know the sticky key activation worked. For example, if you wanted to use the Ctrl-P key combination, you would use the following sequence of keys: Shift, Shift, Shift, Ctrl <tone>, P. If you wanted to hit the Ctrl-Alt-Del combination to reboot the system, you would use Shift, Shift, Shift, Ctrl <tone>, Shift, Shift, Shift, Alt <tone>, Del. OS/2 implementation of sticky keys is a bit klunky, but it works, even in DOS and Windows sessions.—*Joe Salemi* □



Figure 8: OS/2 2.0 lets you make the shift keys sticky through the special needs page of the keyboard settings notebook.

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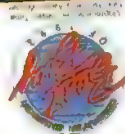
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Color

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T3300SL

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- 2MB RAM, 120 MB hard drive

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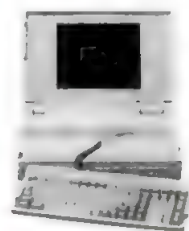
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Processor		DOS	Trackball
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386SX25.80MB		\$1699	\$1799
386SX25.80MB		\$2369	\$2449
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T3300SL

- 25MHz 386SL
- 2MB RAM, 120 MB hard drive
- \$2199**
- T4400SX**
- 25MHz 486SX
- 2MB RAM, 120MB hard drive
- \$2489**

Lease for \$80.70/mo.

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T6400

- 4 MB, expandable to 36MB
- Full 101-key keyboard
- One full length expansion slot

Processor	Hard Drive	Price
486DX33 plasma	120MB	\$3999
486DX33 plasma	200MB	\$5999

Lease for \$146.76/mo.

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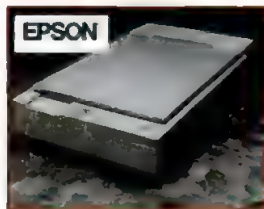
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- ✓ Optional 250 Sheet Tray
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- ✓ HP Compatible Font Slot
- ✓ Parallel Interface
- ✓ 9" h x 14.5" w x 18" d 22 lbs
- ✓ 2 Year Warranty

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ACTION LASER 1500

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- ✓ 68000 CPU/16.7 Mhz
- ✓ 150 Sheet In/100 Out
- ✓ 6 PPM
- ✓ 300 x 300 Dots Per Inch with RIT
- ✓ HP Compatible Font Cartridge Slot
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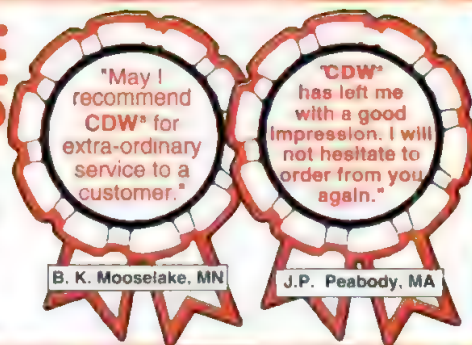
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- ✓ Grammar 5 (Grammar Checker)
- ✓ New Button Bars
- ✓ Adobe Type Manager with Type 1 Fonts
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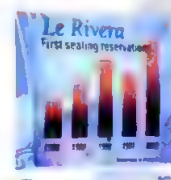
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DeskPro 386/16	1Meg Kit	108071-001	99.00
	4Meg Kit	108072-001	269.00
	1-2Meg/4-Meg Exp Bd	108069-001/108070-001	239.00/399.00
DeskPro 286	512K Kit	113012-001	59.00
Proline 4/33	1Meg/2Meg	141682-001/141683-001	55.00/98.00
	4Meg/8Meg	141684-001/141685-001	159.00/319.00

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Compaq SLT/386	1Meg Module	118303-001	79.00
	2Meg Module/4Meg Module	118304-001/118305-001	109.00/179.00
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Compaq Lite Lite/20, 25	4Meg Module	129769-002	179.00
Compaq Lite Lite/20, 25	8Meg Module	129769-003	389.00
Compaq Lite Lite/20, 25	16Meg Module	N/A	Call
Compaq Contura	2Meg/4Meg	139497-001/139498-001	89.00/169.00
386SL, 320, 325	8Meg/16Meg	139499-001/N/A	319.00/759.00

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16Meg Kit H-98229D — 899.00	32Meg Kit H-98229E — 1699.00	
Vectra 486S/20PC, 486/25T • 486/33T, 486PC	1Meg D2150A — 59.00	4Meg D2151A — 159.00
Vectra 386/25PC, 486S/20PC, 486/PC, 486/25T, 33	2Meg D2381A — 99.00	8Meg D2152A — 329.00

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386/33E, 486/25E — 2Meg — 169.00
386/33L Express Te & E — 1Meg/4Meg/16Meg — 69.00/149.00/649.00

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T2000SX/T1000LE	8Meg	PC14-PA8315U	269.00
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T2000SX/2200SX/T1800 1850 C	4Meg	PC14-PA2001U	149.00
T2000SX/2200SX/T1800 1850 C	8Meg	PC14-PA2002U	269.00
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T4400SX, SXC T6400	4Meg	PC14-PA2004U	179.00
T4400SX, SXC T6400	8Meg	PC14-PA2005U	349.00
T4400SX, SXC T6400	16Meg	PC14-PA2010U	699.00
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T3200SX	2Meg	PC19-PA8318U	84.00
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NEC Prospeed 286 386SX-16	4Meg	PC21-22	179 00
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Ti Travelmate 2000	1Meg	2568034-0001	85 00
Ti Travelmate 3000	2Meg	2568996-1	79 00
Ti 4000	4Meg, 16Meg		269 00, Call
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SX Alpha	2Meg	ZA-180-86	119 00
SX Beta	2Meg	ZA-180-87	119 00
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Everex Tempo LX, LX20	2Meg	PCA 00053-0001	89 00
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Epson NB/SL 20, 25, 25C	2Meg/4Meg/8Meg		129 00/219 00/499 00
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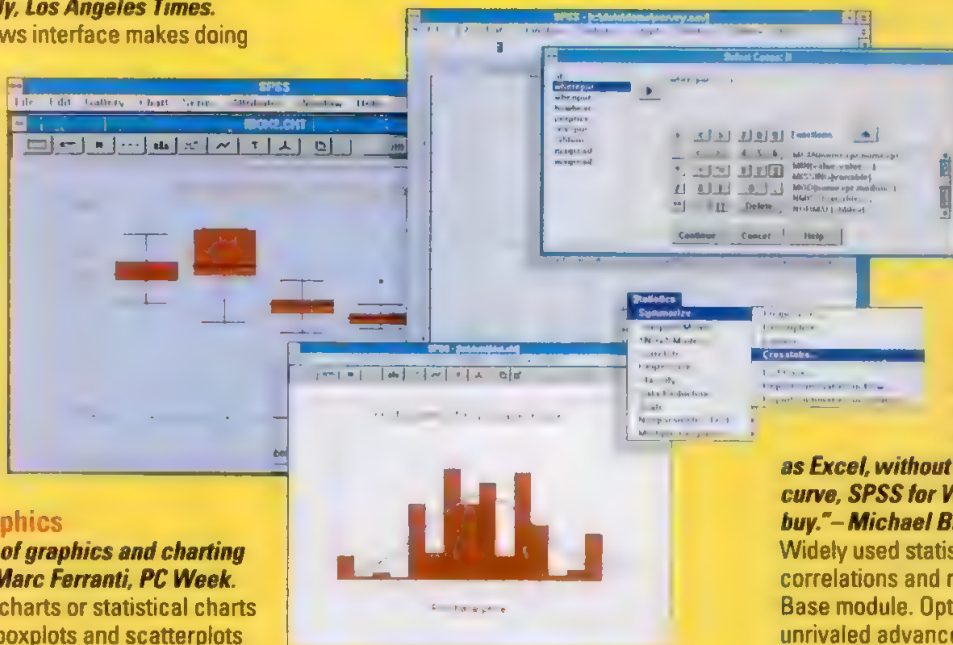
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PS/1 Consultant all models except Cxx series			
486 969290	\$150	16MB 969291	\$379
PS/1 Consultant, Essential and Expert models K76			
16MB Kit	969291		\$379
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286 Kit	3095380		\$89
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286	6450604 or 90X0625		\$79
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486	54F2953 or 82F9977		\$149
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286	6450902		\$49
PS/2 90 XP, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Consultant, Essential and Expert models 211, 213 and 214, PS/1 Pro M2123			
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486	6450130		\$309
PS/2 90-111, 311, 321, 321, 001, 161			
286	6450570		\$99
PS/2 90-A21, A31, A41			
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2-16MB w/286	6450460		\$309
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286 500510-002	\$89	486 500510-000	\$179
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286 500510-002	\$89	486 500510-000	\$179

Compaq

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48MB Module	115132-001		\$169
16MB Board	115044-001		\$119
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Compaq			
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686	\$329		
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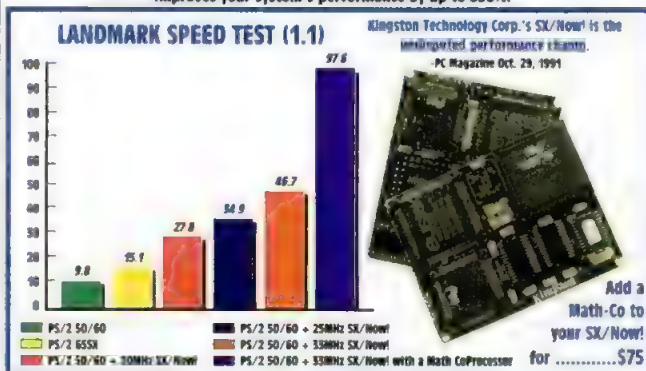
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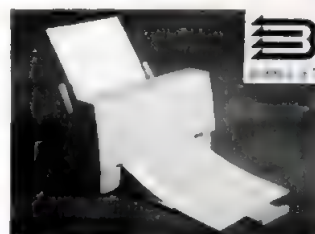
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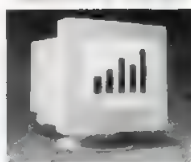
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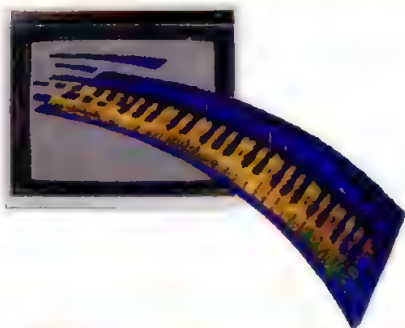
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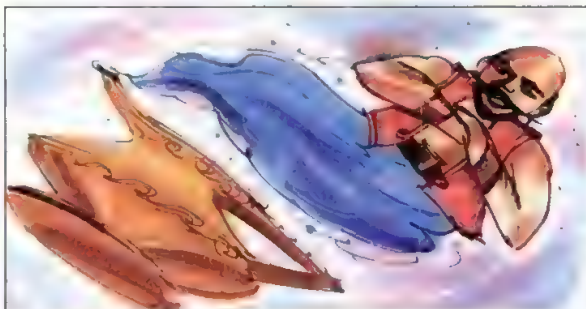
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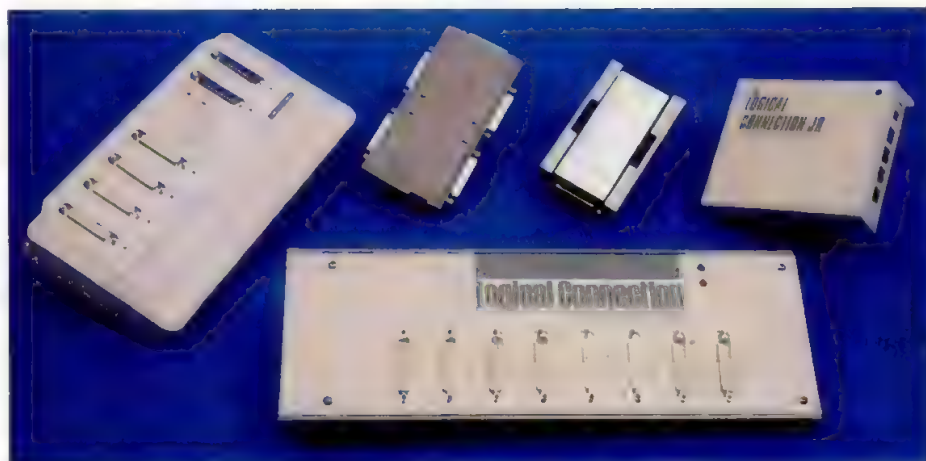
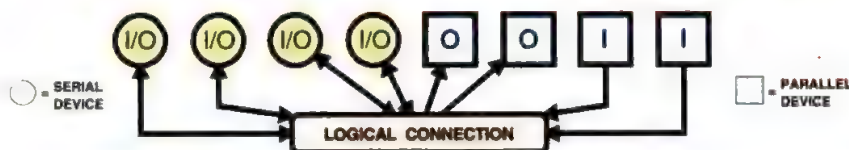
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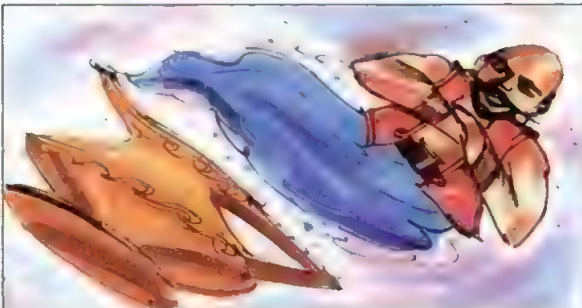
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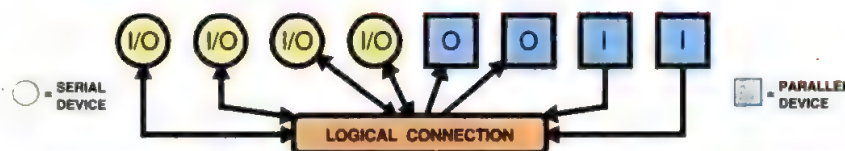
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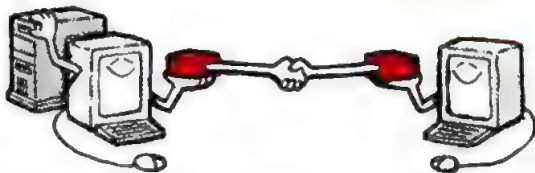
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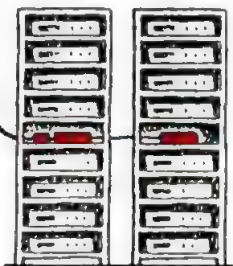
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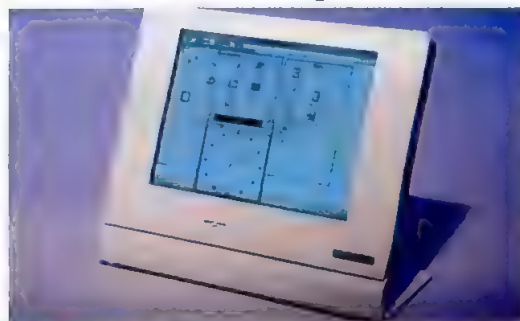
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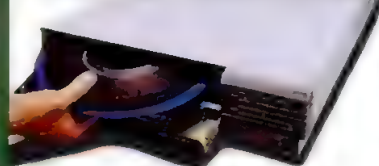


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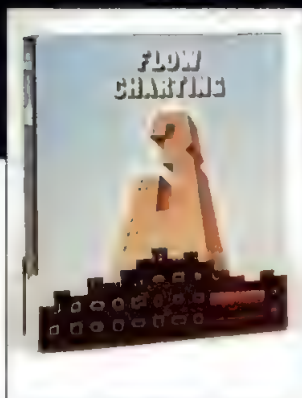
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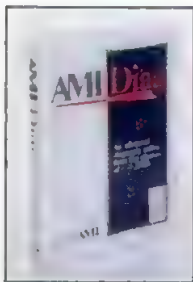
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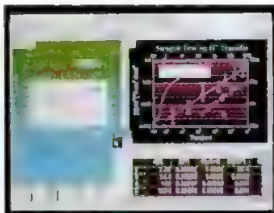
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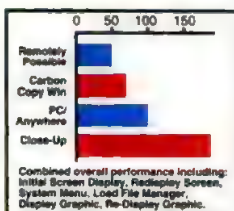
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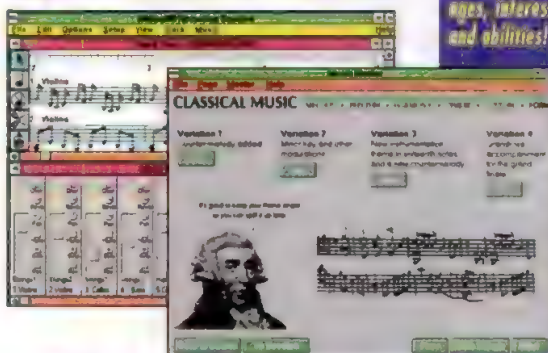
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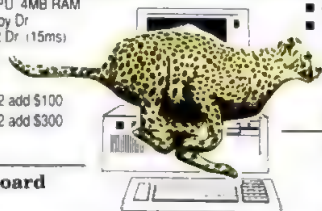
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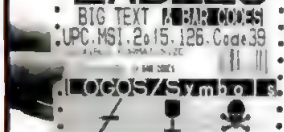
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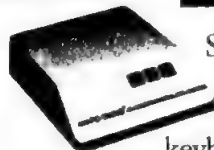
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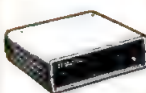
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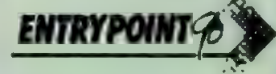
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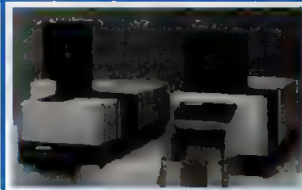
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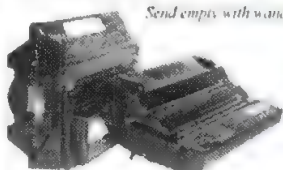
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 02. ☐ 11-25 04. ☐ 100 or more

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01. ☐ Linked to mainframe
 02. ☐ Linked to mini
 03. ☐ Networked together

7. Please check the equipment currently installed at your location. (Check all that apply.)

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 02. ☐ IBM or Compatible Mainframes
 03. ☐ IBM or Compatible Minis
 04. ☐ Macintosh
 05. ☐ CD-ROM
 06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months
 02. ☐ In 4 to 6 months 04. ☐ No definite plans

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Coming Up

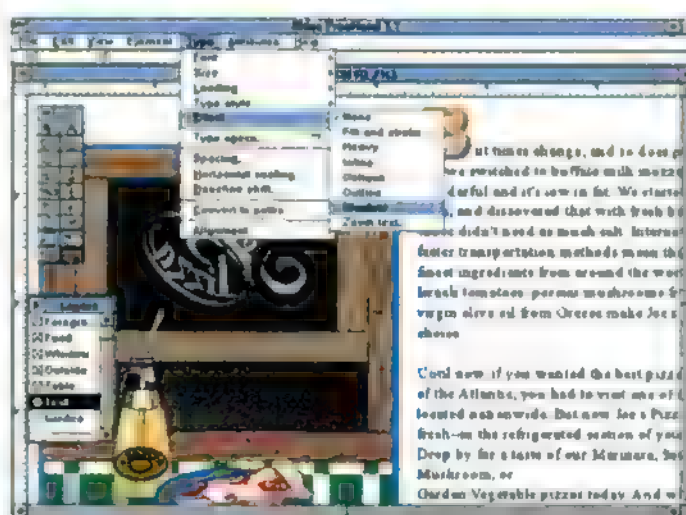
New Power Portables

Computer makers continue to build a wider variety of desktop features into their notebook offerings while at the same time wringing out every last volt of battery power. Still, buyers are demanding even more. *PC Magazine* tests 30 of today's state-of-the-art mobile powerhouses and takes a look at what tomorrow holds in store—high-end 486 processors, new built-in pointing solutions, low-power low-heat chip sets, and, of course, ever more color.

Networking

Routers are a crucial element in building an enterprise-wide network; not only do they allow the savvy manager to connect far-flung LANs, but they also allow control of the ebb and flow of information among those networks. *PC Magazine* reviews ten multiprotocol routers that offer support for SNMP (Simple Network Management Protocol).

High-End Illustration Software



Manipulate lines, text, shapes, and colors with high-end illustration software.

Working with lines, shapes, text, and color, anyone can create high-quality artwork for newsletters, slide shows, and more.

Free Utility

In the next issue, we'll present two utilities: BOOT2C and BOOTPW. If you always forget to remove your floppy disks before rebooting and are constantly getting a "Non-system disk or disk error" message, you'll appreciate BOOT2C. It will let you force a boot from the disk you select and avoid this message in the process. The second program presented in this issue, BOOTPW, lets you password-protect your disks. Once protected, your disks won't be recognized as valid disks by either DOS or OS/2. □

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LANGUAGE SOFTWARE

Say It in French, Spanish, Japanese: Language Programs Translate, Teach

BY BARRY BRENESAL

Lscuche. Hören Sie. Écoutez. Ascolti. In other words, *listen up*. Language courses were once the exclusive province of traditional schooling, then they rode the home electronics boom out of the classroom and onto cassette decks. Today's exponentially more sophisticated PC market has brought forth still another wave of language tutorials, this time in DOS and Windows, on hard disks and CD-ROM drives.

The four programs in this review are designed for fledgling students, and each has a slightly different focus. Berlitz Think & Talk is a good overview that uses a tried-and-true method. Language Assistant aids in translation. Playing With Language, a CD-ROM program, is ideal for teaching children foreign language skills, and Power Japanese is a dazzler designed to introduce the student to both the spoken and written word.

Expect little regional emphasis in these computerized language tutorials. You should get up to speed with one of these courses first, and then refine your skills with the help of shortwave broadcasts, an advanced college-level course, and, best of all, travel.

HYPERGLOT SOFTWARE

Berlitz Think & Talk

The Berlitz Think & Talk series might well be named Listen, Read, Write, & Talk. These four steps provide the structure for this multimedia program, a literal transcription of the cassette-based Berlitz series to eight compact disks.

The discs contain 50 scenes, with several related dialogues in which changes of setting incorporate new words. The acting is good, and the sound effects are realistic. First, you "Listen" to a scene. When you're familiar with what you've heard, you go on to "Read," with scrolling transcript accompanying the verbal material. "Write" is a transcription exercise based on the same scene. In "Talk," you can record parts of the scene and then play them back; you'll need a microphone for this task. When you complete all four steps, you advance to the next scene.

The computerized interface joins the product's audio and visual elements more closely than a book and a cassette ever permitted; you can highlight any portion of written dialogue in the Read section, for instance, and play it back. Playing your own recordings lets you hear differ-

ences of pronunciation in a way no cassette can supply.

The Write section of Think & Talk, however, is of highly questionable use. Berlitz deliberately avoids giving you rules and grammar, so it's hard to figure out individual letter-to-sound associations. Accurate written reproduction is made still harder in a language with complicated accents like French, and extensive verbal word linking, like Spanish.

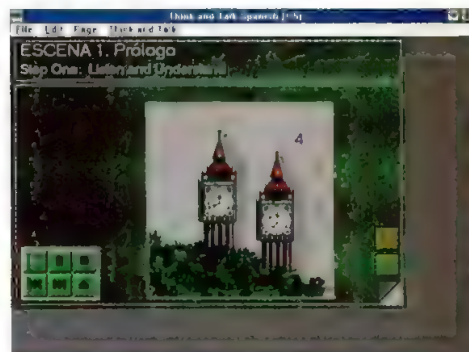
Other elements of Think & Talk completely miss multimedia's possibilities. The online dictionary furnishes translations and written pronunciations but no spoken ones, which is especially unfortunate considering Think & Talk's emphasis on verbal cues. The written exercises at the conclusion of each scene are no more than a few brief, multiple choice questions, without verbal accompaniment.

Berlitz Think & Talk becomes more powerful when combined with other DOS- and Windows-based programs from Hyperglot. The Pronunciation Tutor series features digitized, though slightly muffled, voices speaking thousands of words. French, Spanish, Russian, Chinese, and German versions are available. Extensive, well-detailed notes explain aspects of pronunciation that are usually overlooked in the rush

to acquire vocabulary. Hyperglot's Tense Tutor emphasizes French, Spanish, German, and Italian verbs, using digitized voices to read more than 200 sentences.

VOCABULARY TORTURE

The Word Torture series offers automated vocabulary drills that you can modify by adding words and phrases. Word Torture comes with three predefined sets of terms. You can narrow or broaden the focus to fit as many words into a session as you want. There's also a flash card mode that whisks away the word you're viewing if a translation



Berlitz Think & Talk: A literal transcription of the popular cassette-based series.

isn't typed within a few seconds. I have a weakness for any tutorial whose initializing button reads, "Let the Torture Begin."

The Berlitz Think & Talk system remains an effective method of acquiring basic foreign language skills, but its literal transfer from cassette to computer is disappointingly unimaginative. Treating a PC and a CD-ROM drive like an enhanced cassette player is a waste of good hardware.

Language Assistant

Berlitz Think & Talk (*French, German, Italian, and Spanish series*), \$199 each. Requires: *Multimedia PC or equivalent, 2MB RAM, 14MB hard disk space, Microsoft Windows 3.1. Hyperglot Software Co., P.O. Box 10746, Knoxville, TN 37939; 800-726-5087, 615-558-8270; fax, 615-588-6569.*

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MICROTAC SOFTWARE

Language Assistant

Strictly speaking, Microtac's Language Assistant series isn't a tutorial at all. It's a series of tools that aid in language translation. But the tools are strong enough

to serve many purposes and can supply the foundation for a self-directed course in German, Spanish, French, or Italian.

Each Language Assistant program consists of two major sections: reference tools and a translator for ASCII text. Reference Tools is a series of five translation utilities that load as an 8K TSR. Two of the tools provide instantaneous translation to or from the foreign language. They use Microtac's fine on-line dictionary, which contains more than 100,000 words and is easily supplemented or changed to reflect idioms and regional forms of standard speech.

A third tool supplies comprehensive conjugations for

more than 2,000 verbs in more than a dozen tenses. If you forget the differences between present perfect, preterit perfect, and conditional perfect, there's excellent on-line help.

This grammatical assistance is expanded in Language Assistant's fourth tool, Grammar Help Topics. Here you'll find extensive, cross-referenced help on more than 35 subjects, from comparative adjectives to reflexive pronouns in your chosen language. The fifth tool is an easy-to-use accent entry utility that adds diacritical markings, foreign characters, and punctuation to your documents.

Language Assistant's second specialty is the bidirectional, sentence-to-sentence

translation of ASCII text. Language Assistant analyzes many grammatical factors, and the results can be surprisingly idiomatic. The program understandably works best when sentence structure is kept relatively simple, however.

Translation options let you determine the document's tone (such as familiar versus formal) and set author gender in first person references.

Microtac's 5.0 release of Language Assistant marks a significant improvement over the last release, Version 4.1, which translated only English to the foreign language. Memory usage in particular has been completely overhauled: The 8K TSR of Reference Tools took 120K in the last version. Internal caching and use of all available expanded memory have been added to speed up searches. Either or both can be turned off with command line switches—important if you access Language Assistant inside a multitasker such as DESQview.

Another new feature is the sentence-diagram tree. Each tree is a syntactical display of a given sentence, with reference points among words that establish and explain areas of morphological agreement. It's definitely not for the faint of heart, but more advanced linguistics students will appreciate Language Assistant's internal logic and will draw conclusions that aid in the development of larger, more complex sentences.

WORD PROCESSING AID

Microtac provides conversion specifications for 14 DOS- and Windows-based word processors. The products launch from Windows, but there's no mouse support.

The Language Assistant series is very impressive. It

■ Tour de Vocabulaire: French Tutorial on a Budget

Got ten bucks and a little space on your laptop? Tour de Vocabulaire is a shareware French language tutorial with an interesting premise, a great price, and very few requirements.

You're touring France by car, taking the road from Grenoble to Lyons, Lyons to Dijon, and so on. Your progress along a 2-D map is determined by picking the right translations for various French words. Five correct translations in a row gain you 25 bonus kilometers. There's one more complication: Three questions on French history at the game's start give you a chance to increase your speed and get more mileage out of each correct vocabulary answer.

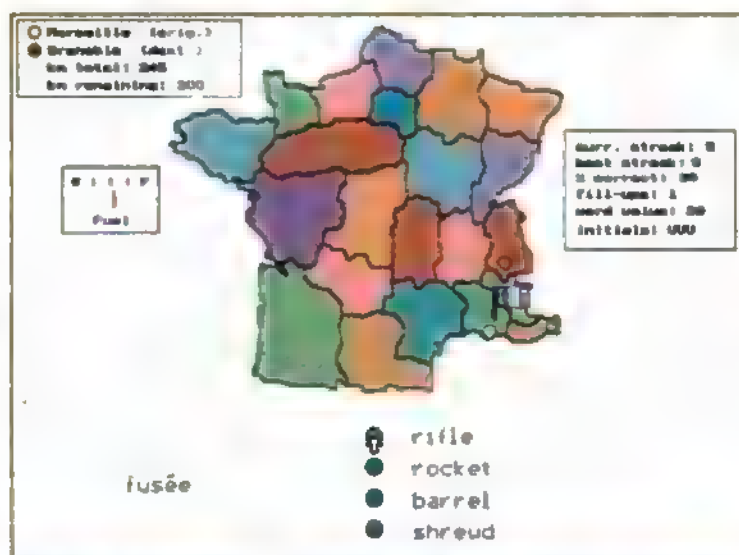
In essence, Tour de Vocabulaire is a simple multiple-choice quiz. But its hi-res EGA screens detailing your progress across the French countryside are attractive. The goal-oriented structure is less abstract than other compa-

nies' similar vocabulary builders, where the only measure of success is the number of right and wrong answers. The only drawback in Tour de Vocabulaire's approach is its nonconfigurable word selection. You can't add or change vocabulary to suit your personal requirements.

Tour de Vocabulaire's modest memory (256K) and space (319K) demands, its mouse and keyboard support, and its suitability to any graphics adapter also make it an ideal laptop companion. Best of all, Tour de Vocabulaire is shareware, so you can download it from bulletin boards and try it out for a short amount of time. When

you register, you get free tech support, a printed manual, and notice of upgrades. **Tour de Vocabulaire**, \$10. Requires: 256K RAM; DOS 3.0 or later. Jim Dowd, P.O. Box 15124, Scottsdale, AZ 85267-5124; 602-596-1903.

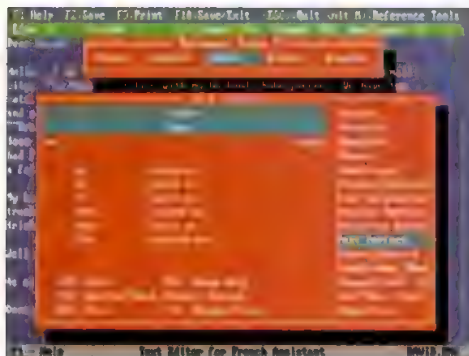
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Tour de Vocabulaire: A quick and easy French vocabulary builder available as shareware.

Playing With Language

translates effectively, providing insights into the language you're studying along the way. And it reinforces knowledge gained elsewhere, with a TSR packet of Reference Tools that include dictionaries and help with grammar. Not a contestant for the first program to



Language Assistant: Translation tools and grammatical guides to French, Spanish, German, or Italian.

purchase as language tutorial software, Language Assistant should be everybody's second.

Language Assistant (French, German, Italian, and Spanish series), \$99.95 each. Requires: 640K RAM, 2.5MB hard disk space, DOS 2.1 or later.

Microtac Software, 4655 Cass St., #214, San Diego, CA 92109; 800-366-4170, 619-272-5700; fax, 619-272-9734.

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SYRACUSE LANGUAGE SYSTEMS

Playing With Language

Playing is fun, and that's one way children first learn language: It's a game between them and their parents. Syracuse Language Systems' (SLS) Playing With Language CD-ROM series uses this method to teach children new verbal foreign language skills.

Playing With Language won't teach reading or writing in the foreign language, but

the multimedia CD-ROM package will teach a child to speak and recognize hundreds of vocabulary words in French, Spanish, German, or Japanese. (There's an English version, too, for children learning English as a second language.) Playing With Language contains 27 different games: nine each on three levels of increasing difficulty. Each game has from two to six levels of its own. Many of these games require you to identify objects such as eating implements, numbers, or household appliances. On the first level, you might be asked

to select a triangle out of a field of six shapes. The next level would add colors: Select a green circle, for instance. The third level would add size: Select the small red square. These tasks sound easy enough, but they prove more difficult when the request is stated in an unknown language.

On higher levels, jigsaw puzzles and bingo games add to the challenge. Concentration games briefly display a panel of six items, blank them, and then require you to click on three or more hidden objects in a stated order. Sound easy? Not in a foreign language. But it's definitely fun.

INSTANTANEOUS RESPONSES

SLS's multimedia implementation is excellent. Responses to the user's selections are instantaneous and sufficiently varied in both praise and correction. Note, however, that Playing With Language will not let you multitask in Win-

dows. SLS designed the package that way, to keep children out of other programs.

Playing With Language is a complete success at what it does, though adults will want much more. Categories like foods and clothing are good learning choices, but the vocabulary is extremely limited—only six kinds of food, for instance. SLS expects to release an adult version of Playing With Language later this year, with several thousand words. That version will also have more varied and complex puzzles with topical vocabularies of use to travelers.

Playing With Language is a superb tool for developing foreign language skills in children, though adults playing with their children may learn a thing or two, too. The package achieves its goal with good-natured fun.

Playing With Language

(English, French, German, Japanese, and Spanish series); \$69.95. Requires: Multimedia PC or equivalent, 2MB RAM, 1.2MB hard disk space, Microsoft Windows 3.1. Syracuse Language Systems, 719 E. Genesee St., Syracuse, NY 13210; 800-688-1937, 315-478-6729; fax, 315-478-6902.

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BAYWARE

Power Japanese

Shifting global patterns have resulted in a need for more American businesspeople to learn Japanese. Several computer tutorials have appeared lately, but BayWare's Win-



Playing With Language: Familiar games like Bingo and Concentration teach kids foreign language skills.

dows-based Power Japanese is the most interesting.

Power Japanese's on-line tutorial is a colorful, well-organized document that makes consistently excellent use of its graphical interface. The developers took nothing for granted, considering the technical limitations of the Windows 3.0 environment under which the product was developed.

This \$389 package contains more than disks and documentation: Hiragana and Katakana exercise books, a small Japanese-English dictionary, and a group of Japanese-character flash cards supplement the tutorial. Likewise, an external sound adapter and headphones allow anyone with a PC and Windows 3.0 or later to listen and learn.

Power Japanese's artistic visuals conceal a well-structured regimen. In the first section, each group of newly introduced Japanese syllables is followed by a succession of listening, reading, and writing drills. You can skip the drills, but the program asks you twice in no uncertain terms if you really want to do that; shame should prevent you from continuing. There are also overview discussions of the Japanese language, which explain concepts puzzling to Western students, such as the

Power Japanese

language's use of unpronounced syllables and syllables without meaning.

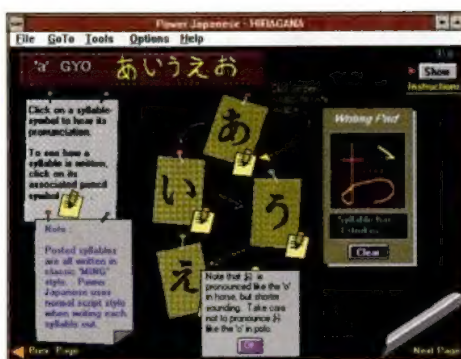
The program furnishes more than 2,000 very clearly spoken recordings, which accompany the illustrations and on-line text. There are dialogues, translation and word drills, and helpful cultural notes such as how to soften a spoken request and the three basic levels of linguistic politeness. Embedded note buttons provide procedural and drill instructions and avoid crowding out the images. When the pointer stops over a Japanese word or phrase, it converts to a cross hair and a translation box appears.

There's no spoonfeeding in this tutorial, but due allowance is made for the difficulties facing students who must

master both a foreign language and a foreign alphabet. Complex ideograms, for example, aren't displayed initially as finished products. They're drawn one line at a time, with each line highlighted in a separate color.

NOT QUITE MULTIMEDIA

Power Japanese has some multimedia capabilities, though it's not yet on CD-ROM, and it doesn't use the Windows 3.1 Multimedia Extensions. BayWare supplies its own sound drivers, and its sound adapter plugs into a parallel port (though it does not allow for printer pass-through). Though the original



Power Japanese: A Windows-based dazzler that teaches users to read, write, and speak Japanese.

version was not compatible with other sound cards, BayWare now supplies a Sound Blaster- and AdLib-compatible upgrade.

Power Japanese could have benefited from multimedia in one other significant way: as an alternative method of data storage. The Hiragana and Katakana syllable sections take 5MB each; and the main

grammar section is split into two segments, each requiring 16 and 8MB. Any segment can be loaded separately, but the extra installation time (and the juggling of 14 high-density floppy disks) is the least attractive feature of the Power Japanese program.

That aside, Power Japanese is a highly successful product. It harnesses all the features of pre-Multimedia Windows and uses great imagination in a state-of-the-art language tutorial. □

Power Japanese, \$389.

Requires: 3MB RAM, 16MB hard disk space, Microsoft Windows 3.0 or later. BayWare Inc., 1720 S. Amphlett Blvd., #205, San Mateo, CA 94402; 800-538-8867, 415-312-0980; fax, 415-578-1884.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Robin Raskin

**And I Only Am Escaped
Alone to Tell Thee**

"Becoming a computer manager in the electronics industry leads to ulcers and other serious ailments, and can even kill. In the case of Fujitsu, Kanjiro Okada was struck down by disease toward the end of his term as president, with [Toshio] Ikeda the next one to go down. The same month Ikeda died, November 1974, President Kora fell ill and stepped down from the post of president to become an advisor. The seventh president, Seimiya was also felled by sickness after only 16 months at the helm, with Kobayashi succeeding him."

—FUJITSU: WHAT MANKIND CAN DREAM
TECHNOLOGY CAN ACHIEVE BY FUJITSU
CHAIRMAN TAKUMA YAMAMOTO

10 YEARS AGO IN *PC MAGAZINE*

We called it the PC "one and a half" when IBM announced the Personal Computer XT, ten years ago in a New York hotel. The enhanced version of the PC gave us a 10-megabyte hard disk and DOS 2.0. We predicted that IBM was on its way to "sewing up the computer market."



We also became convinced that 1,200-baud modems could theoretically reduce connect time by 75 percent.

And for turtle aficionados, Gary Kildall, then president of Digital Research, introduced a souped-up version of LOGO, DR LOGO.

PC or Chrysler Cordoba?

CCS describes its Portable Office System, a briefcase with integrated PC, cellular phone, printer, CD-ROM drive, and modem, as "A Unique Blend of Sophisticated Leather and Power."

If your entry is used in *Abort, Retry, Fail?* we'll send you \$50 and a *PC Magazine* T-shirt. Winners this issue: Don Willmott (death and executives), Emerson A. Torgan (leather power), Chris Niggler (modern memory).

BUZZWORD WATCH

whoopie-cushion multimedia As opposed to serious multimedia.

First heard: Rob Lippencott of Lotus Development Corp.

Static Employees Are In for a Shock

"Unlike other heel grounders on the market, the Graseby Plastic Systems design is engineered for comfort; yet remains intact while the user is walking."

—GRASEBY PRESS RELEASE



Don't Want to Go Out on a Limb. . . .

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—*INFOWORLD*, AUGUST 17, 1992



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